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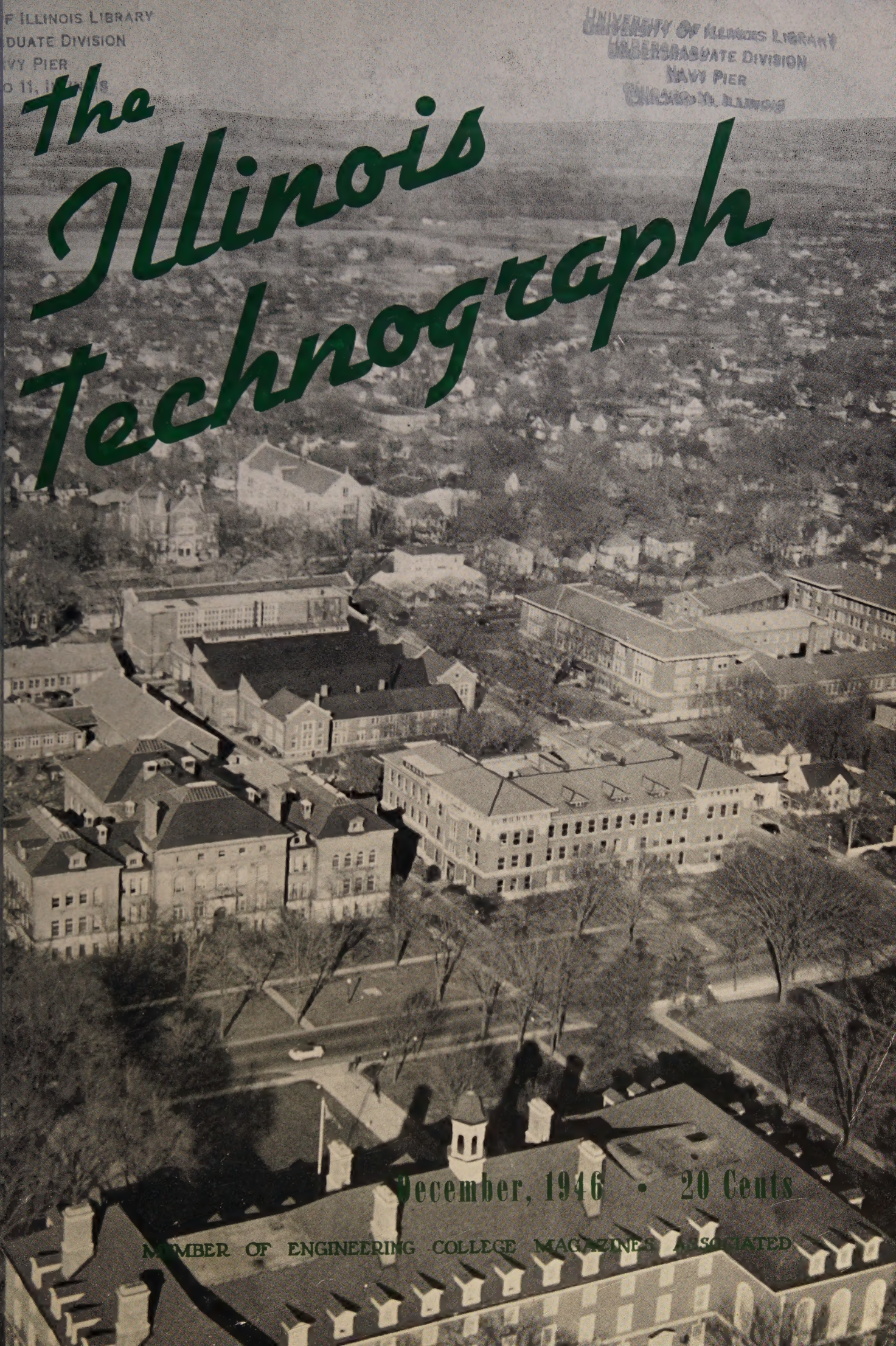
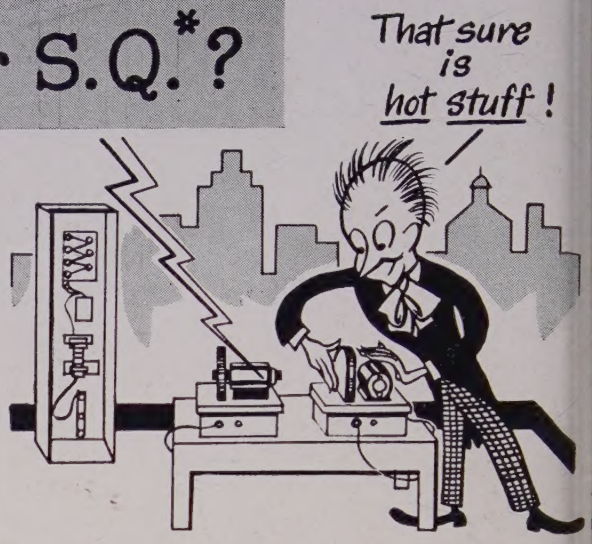


December, 1946 • 20 Cents

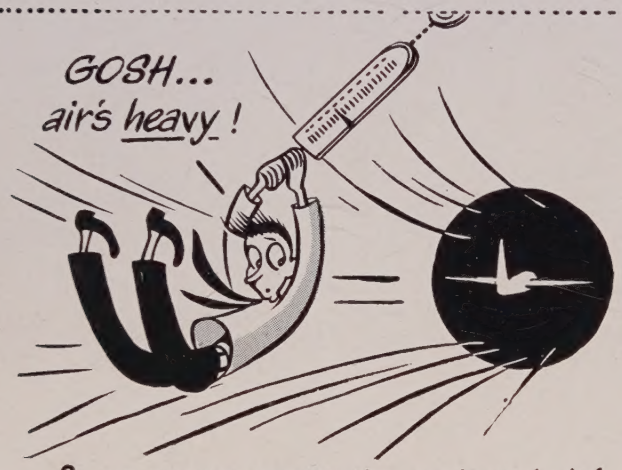
MEMBER OF ENGINEERING COLLEGE MAGAZINES ASSOCIATED

What's your S.Q.*?

1. **WHAT IS THE TOTAL WEIGHT** of the electrons flowing through a 100-watt lamp filament, burning continually for one year on a 115-volt circuit — (a) 150-billionth ounce, (b) 5460-millionth ounce, (c) 2⅜ ounces?

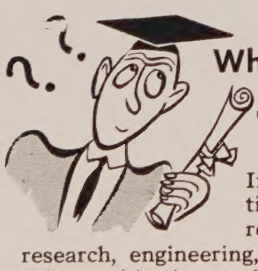


2. **WHAT IS THE AMPERAGE** of the average thunderbolt — (a) 20,000 amperes, (b) 1,700,000 amperes, (c) 4,000,000 amperes?



3. **AIR PASSING THROUGH** the experimental wind tunnel at Wright Field, during a single hour, weighs as much as — (a) Army "jeep", (b) electric locomotive, (c) medium-size ocean liner?

4. **THE PUREST FORM** of iron ever produced is used in — (a) arc-welding electrodes, (b) thermostatic controls, (c) spectrum analysis?



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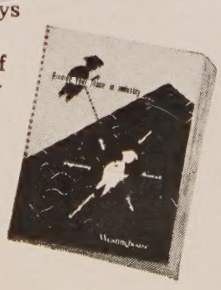

Write: University Relations, Educational Department, Westinghouse Electric Corporation, 306 Fourth Ave., Pittsburgh 30, Pennsylvania.

ANSWERS

1 — (b) *Six million trillion electrons flow through a 100-watt filament every second at 115 volts — 17.1×10^{25} electrons per year — weighing about .005 ounce.*

2 — (a) *The intensity and duration of lightning strokes are measured and recorded automatically by the "fulchronograph" — developed by Westinghouse engineers.*

3 — (c) *Every hour, about 27,000 tons of air are driven through the Wright Field wind tunnel by a 40,000 hp electric motor — designed and built by Westinghouse engineers.*

4 — (c) *Iron 99.99% pure, is essential for comparison purposes in spectrography. It is produced in the Westinghouse Research Laboratories by fusing the purest commercial iron obtainable in a high frequency induction furnace, surrounded by an atmosphere of hydrogen gas.*

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Timken introduced the tapered principle over 48 years ago to obtain an anti-friction bearing with the ability to carry radial loads, thrust loads or any combination of the two. During the ensuing long period of engineering development and experience, a constant refinement of design has taken place, making the Timken Bearing of today supreme in performance.

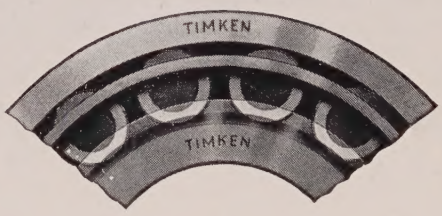
Here are the three most important features exemplified in the design of the Timken Bearing.

1. TRUE ROLLING MOTION

This basic necessity is accomplished by making all lines coincident with the tapered surfaces of the rollers, cup and cone, meet at a common apex on the axis of the bearing, Figure 1. True rolling motion always has been incorporated in the Timken Bearing.

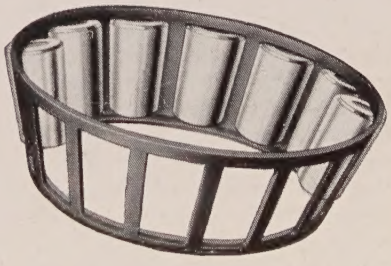
2. POSITIVE ROLLER ALIGNMENT

During the development of the Timken Bearing, as speed, load and accuracy requirements increased, various methods were used to stabilize the rollers and prevent them skewing on the raceways. The problem finally was solved by so designing the roll end and cone rib, that when generated during bearing production, perfectly smooth, mated working surfaces are obtained at the contact area, which keeps the rollers positively and permanently aligned on the raceways, reduces friction at this vital point to the minimum and eliminates initial wear. The light areas on the ends of the rollers in Figure 2 show generated contact of roller ends with cone rib.



3. MULTIPLE PERFORATED CAGE

All the openings in the Timken Bearing cage, Figure 3, are stamped out in one operation by means of multiple perforating dies made to extremely close precision tolerances. This assures exact center-to-center spacing of the rollers around the periphery of the raceways, so that every roller takes its full share of the load when the bearing is in operation.



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TAPERED ROLLER BEARINGS

New Developments

By John Dick and Francis Green

Electropult Launches Planes From Small Fields

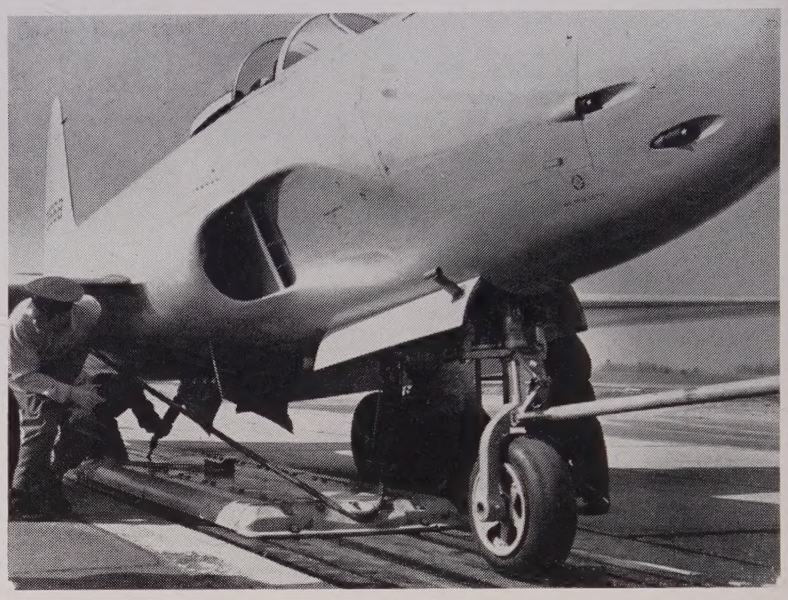
The problem of launching planes from the short runways of small fields and carrier decks is now being solved by use of the Electropult. This new device, designed and built by engineers of Westinghouse Electric corp., has proved very satisfactory in all tests. Jet propelled planes that ordinarily require a run of 2,000 feet are launched by the Electropult after a run of 340 feet at a speed of 116 miles per hour in only 4.1 seconds. Size of the plane to be launched presents no problem because the machine gains in effectiveness as the size of the aircraft increases.

The Electropult is essentially a huge induction motor laid out flat. Its 1,382 foot track corresponds to the rotor of the conventional machine and the shuttle car which runs along it acts as the stator. The shuttle car itself is 11½ feet long, 5½ feet wide, and extends only five inches above the track. A bridle of steel cable is used to harness the plane to the car. The plane rides along the track on its own wheels. When it reaches flying speed the car is stopped, the steel cable falls off, and the plane takes off.

The power supply for the Electropult, a rather complicated affair, is housed in a sunken concrete vault beside the runway. A Pratt-Whitney 1,100 horsepower aircraft engine drives a D-C generator which is connected to a D-C motor. This motor in turn drives an A-C generator and a 24-ton flywheel. The flywheel developes a tremendous amount of kinetic energy when accelerated to its full speed of 1,300 revolutions per minute. This stored energy drives the A-C generator which supplies power to the Electropult during the few seconds required to launch a plane.

Designs have already been completed for an Electropult capable of launching the largest existing air liners at a speed of 120 miles per hour with a take off run of 500 feet. Ordinarily these planes would need about 4,000 feet to reach flying speed. A maximum acceleration of one "G" would be built up during the first two seconds of the take-off. This means that a passenger would be pressed back into his seat by a force about equal to his own weight.

A catapult of this type will find numerous applications wherever short runways have been a handicap such as aircraft carriers, floating airports, mid city airports, etc.



Preparations for launching a plane with the aid of the electropult

Illustration shows a jet propelled plane being readied for launching. The shuttle car can be seen beneath the plane. Mechanics are attaching the towing cable which will be dropped when the plane takes to the air.

Super-Speed X-ray Studies Body Distortions . . .

Millionth-of-a-second X-ray pictures now are being used to study the bodily distortions a flier endures when he makes a crash landing or is catapulted out of a crippled speed plane. In crash landings fliers undergo a shock equivalent up to 10 times the shock to a motorist if he could halt his automobile in one second from a mile-a-minute speed. Deceleration blows can be cushioned, but strains on body organs still are a problem.

Laboratory simulation of actual flying and crash conditions allow sequence photographs to show step-by-step distortion of the organs. With the speed of jet planes rapidly approaching 1,000 mile-an-hour speeds, a man climbing out of a crippled supersonic plane would be cut to ribbons by the wind. The high acceleration necessary to jettison the pilot out so he can parachute to safety gives his organs a jolt of 20 G's.

The speedy exposures of about 20,000 times as fast as the routine medical e posure are accomplished by an electron tube which operates under high mome tary voltage, sending electrons towa the "target" at nearly 100,000 miles second.

Ultra Violet Lamp Preserves Food

Installed in home refrigerators, midget ultraviolet ray lamp emits ba teria-killing rays and produces ozone prevent food spoilage and to purify foo vapors, it was announced by an easte laboratory recently.

Mold growth and food decay, tw food destroyers, proceed rapidly in hig humidity cabinets where temperatur are above normal to preserve flavors, b are forestalled by the new Sterilamp. the lower humidity cabinets which we popular during pre-war days, accumul tion of foododors was the main headac for the housewife. Now the new Ste lamp produces ozone which purifies foo vapors by breaking down vapor mo cules.

Operating on three and one-half wa and only when the refrigerator co pressor runs, the lamp has a useful l of one year. It is installed with a tra former which also consumes three a one-half watts.

›thing," Important Link issionable Uranium . . .

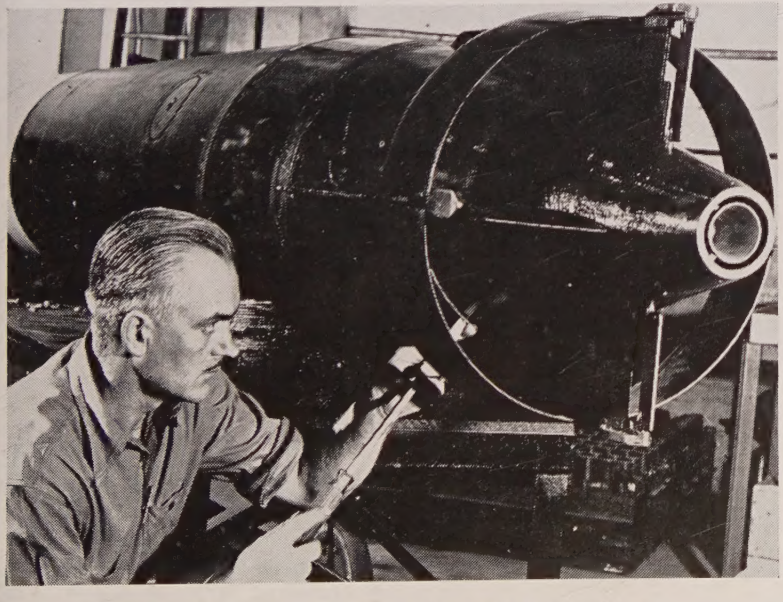
gh speed pumps which may prove ble for food dehydration, blood a and penicillin processing, vitamin lation, oil and chemical production, m casting of metals and vacuum g of paper, capacitors and other cts were a major factor in making tomic bomb possible. More perfect ms created more swiftly and in er quantity than ever before were during the electromagnetic separa- of uranium. These vacuums were possible by the largest oil-diffusion s ever constructed, using heated oil to drive away molecules of air. pumps were especially developed he atomic bomb work by the West- use Electric corporation and the ersity of California.

ard' vacuums were needed to per- electron and ion activity in some of paration machines much as vacuums sed to allow such activity in elec- c tubes. The giant-sized pumps ed vacuums in Calutrons, the elec- l "atom sorters" which separated ium 235 from the two other Ura- isotopes in the electromagnetic sep- on process. The Army's official re- on atomic energy says that this od resulted in large scale produc- of U-235. Smaller versions of the s used with the Calutrons were in the gaseous diffusion method of ating uranium isotopes.

he oil molecules in the diffusion s are heated electrically in a "vat" he bottom of the pump and are ed upward at nearly the speed of sound through a chimney-like sleeve and stream out through jets that are angled sharply downward. These oil molecules entrap the air molecule from the container being evacuated and push them downward and into an eight-inch oil diffusion pump, which operates at a slightly higher pressure, and on out through a mechanical pump, from which they are exhausted into the atmosphere. The cycle is repeated until the pressure in the largest pump is only two hundred millionths of a pound per square inch, compared with atmospheric pressure of 15 pounds. At its full operating pressure, the giant pump can create this 99.999999 per cent perfect vacuum faster than any other pump ever built and can empty thousands of cubic feet of air in one minute. Improved jet design and tapered walls of the pump speed the trapping of the air molecules and account for higher pumping speed.

Moon-to-Earth Radio Broadcasts Foreseen . . .

By combining the recent advances of electronics and rocket power, a compact "rocket radio" capable of carrying a 100-watt transmitter the 250,000 miles to the moon in about 60 hours has been forecast by Associate Director J. A. Hutcheson of Westinghouse Research Laboratories. With 50 pounds of storage batteries and less than 50 additional pounds devoted to an ultrashort wave transmitter and associated clockwork, signals could be sent to receiving stations here on local conditions on the flight to the moon and for several days after it has landed there.



The new "Hydro-bomb" for aerial launching

Dr. Hutcheson proposes to turn the set on for a minute each hour by means of an electric clock mechanism. A tiny transceiver similar to the proximity fuse would set off reverse rockets and turn off forward rocket power at the right instant to eliminate damage of the delicate instruments.

Rocket Powered Torpedoes For Underwater Use

Rocket power is now ready to take its place propelling torpedoes. The development of a rocket propelled torpedo called the Hydro-bomb for launching from a plane has been announced by Westinghouse Electric corp. with the approval of the Army Air Forces.

This new torpedo resembles the regular submarine torpedo in appearance. It carries approximately 600 pounds of explosive in its war head and travels through the water at 40 miles per hour. This compares favorably with other types and the Hydro-bomb is also simple and inexpensive to construct. Its extreme range and accuracy permit the plane dropping it to stay out of range of heavy anti-aircraft fire.

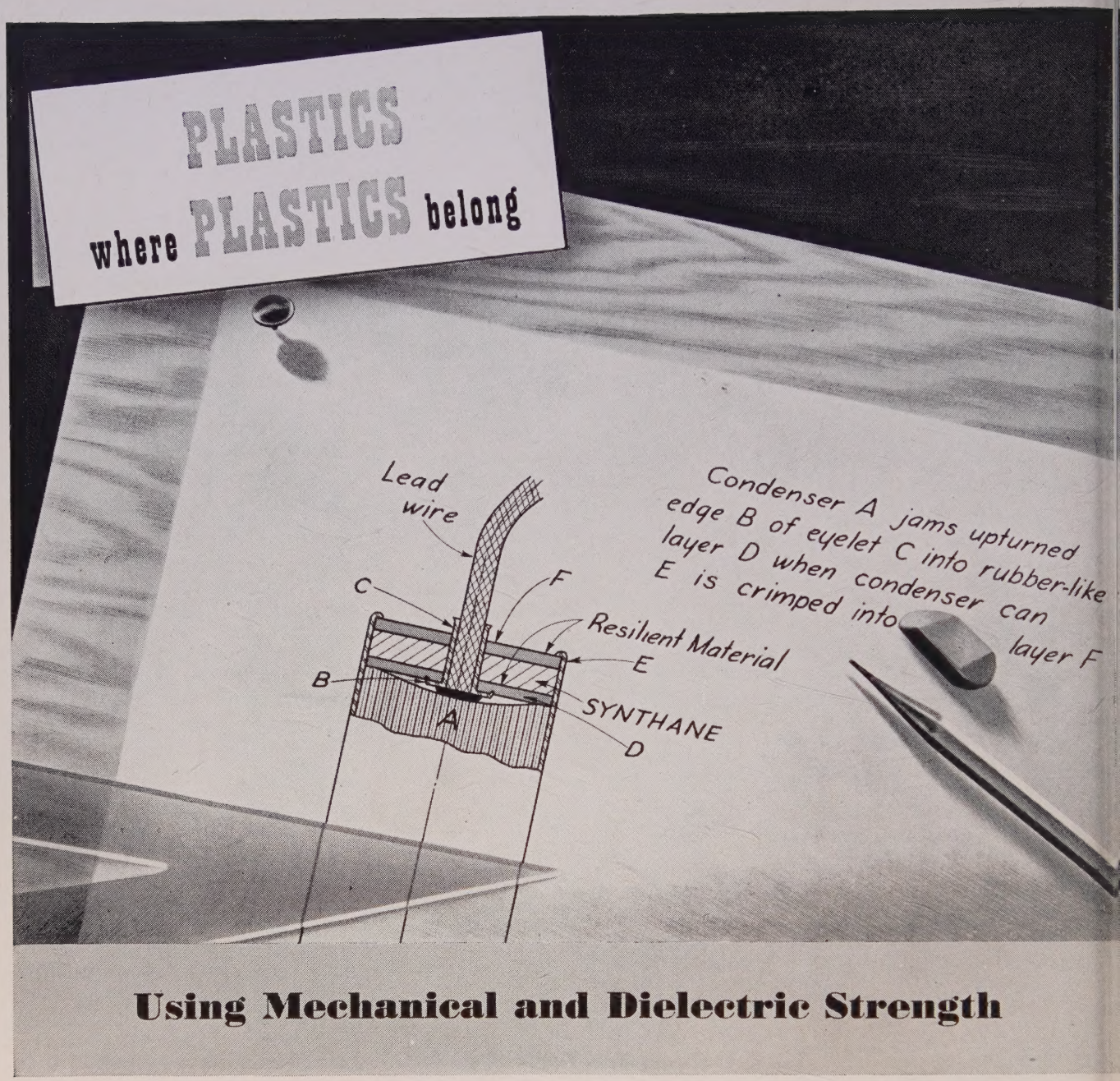
Army requirements demanded that the Hydro-bomb withstand a drop of six hundred feet. Tests from altitudes as high as 2,000 feet left the bomb undamaged and in good working order.

When the bomb is dropped from a speeding plane, the impact on striking the water throws a switch that ignites the rocket motors' solid fuel. Gyroscopic controls keep the bomb on course and special depth controls regulate the depth of its operation under water. A true rocket motor such as is used here can operate under water because it supplies its own oxygen for combustion from the ingredients of the solid fuel.

Metal Takes Own Temperature

A special metal alloy, which tells temperature by color changes, has helped G-E engineers solve the difficult problem of determining the intense and varying heat of the turbine wheel whirling at more than 1,000 miles an hour. The alloy shows a marked color change for every 25-degree change in temperature from 500 degrees centigrade to 700 degrees centigrade, then reverts to its original color and begins the color scale over again from 725 to 900 degrees centigrade.

By making turbine parts of the alloy, the turbine has to show its colors during operation, and by so doing takes its own temperature.



Using Mechanical and Dielectric Strength

SYNTHANE laminated phenolic, sandwiched between and bonded to layers of a resilient material, is the basis of an interesting plastics application.

The assembly—a condenser—depends upon the resilient material for a perfect seal when the edge of the can is crimped. Synthane backs up the resilient material, provides needed strength and rigidity, and is also an excellent electrical insulator, unaffected by condenser oil.

Synthane Fabricated Parts are produced by men who know how to make plastics and how to machine them, using specialized equipment. Synthane Corporation, Oaks, Pennsylvania.

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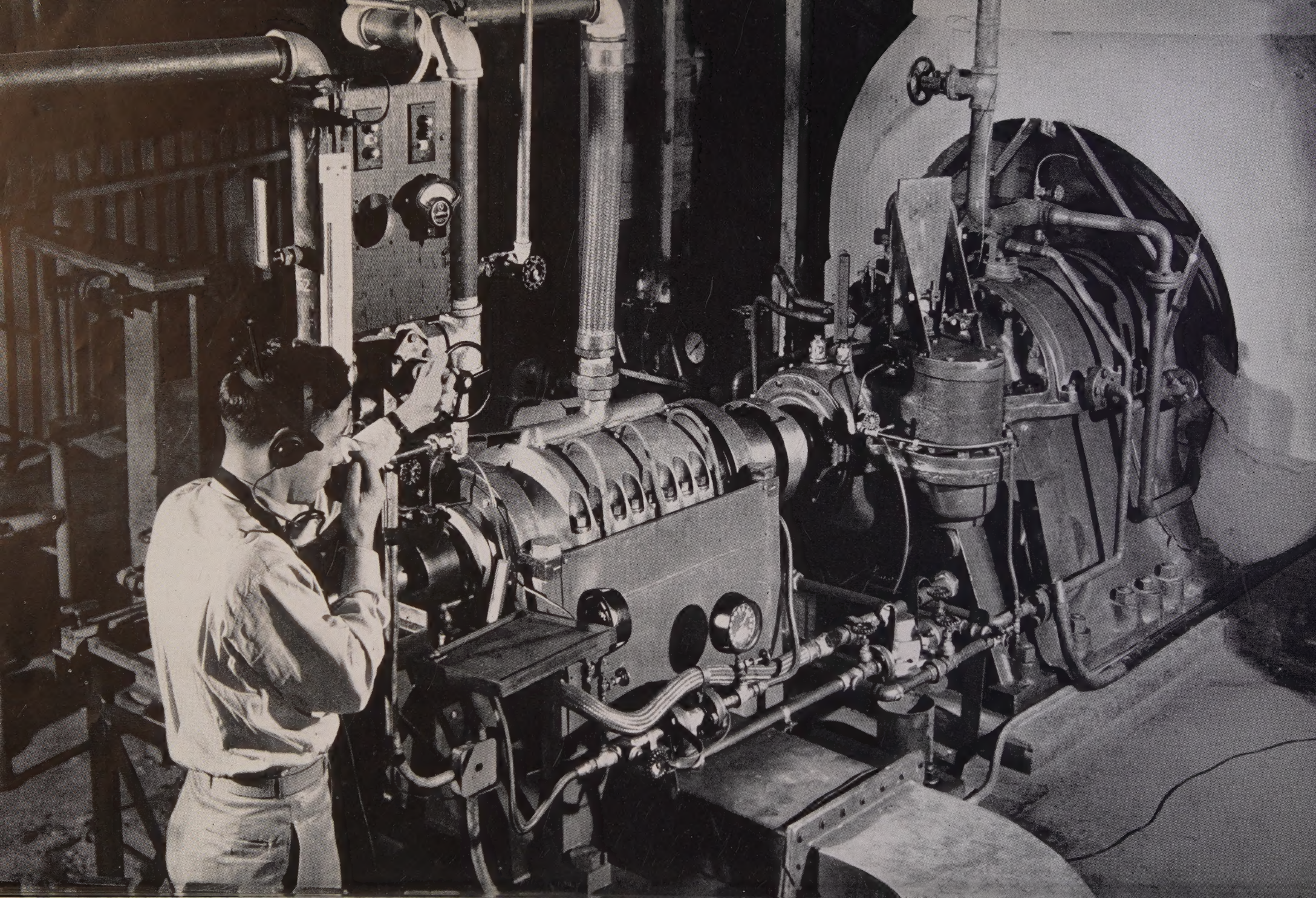
OUR COVER

Air view of the Engineering Campus. Foreground shows the Union with Engineering Hall just across the street.

FRONTISPIECE

Exhaust end of a power turbine. Net power output is assured by the water brake (center).



as Turbines in Industry

By Karl Hilgendorf

With rapid progress being made in the use of gas turbine plants, it is appropriate that engineers be kept informed of the evolution of this new tool in the power field. In about 10 years, the gas turbine has been used in aircraft, locomotives, seagoing ships and stationary land plants. The future of the turbine grows brighter day by day. The turbine costs less, weighs less, and has fewer parts than other prime movers. It may be adapted to use atomic energy.

he versatile gas turbine which has ed an outstanding success in indus- and in military service has shown it will serve where steam power has ite drawbacks. For one, the gadgets many parts that make up efficient r and turbine power plant, the pure r feedwater, the large amounts of condensing water necessary to such nes are drawbacks which the com- on turbine eliminates. The advan- of no boilers, few moving parts (it e-half the length of a Diesel engine delivers equal power), cannot be ooked.

ecently in an attempt to promote the of turbines in railroads, John Yel- chief of the Institute of Gas Tech- gy, headed a project to consider the of powdered coal as a fuel for com- on turbines. The wresting of power inexpensive coal was long a hope ngineers and now since last Decem- a coal-burning turbine has been ling away at John Hopkins Univer-

While our oil supply is rapidly ndling, we have a coal supply which ises to last 3,000 years. And it is per to burn coal directly than to act oil from the coal source material. it is possible to burn any cheap even lignite, which can be found in as, Montana, North Dakota, and ada.

ne advantage of the gas turbine was d in jet planes flying in cold cli- s. In dense cold air, power goes up more air is driven through the tur- with less expenditure of power. Diesel is still the most efficient en- with efficiencies as high as 36%, as pared with 24% for the steam tur- and 30% for central station steam ine. The gas turbine, however, in nal atmosphere has an efficiency nd 30%, with regeneration. Use of will cut costs by one-third. As one er puts it, the recent development of turbine is one of the outstanding de- pments along with radar and atomic gy.

he excellent performance of gas- ine-driven superchargers for our bers and pursuit planes during rld War II is a fact known to all. past performances of the gas tur- has put new emphasis on develop- ment of high temperature materials used in its construction. Gas turbines in turbo-superchargers and in jet propulsion units are operated for long periods of time at 1,500 degrees F. As a matter of fact future success depends on use of a better alloy than the chromium, nickel, tungsten, columbium titanium, molybdenum blade alloy now used.

Applications in Industry

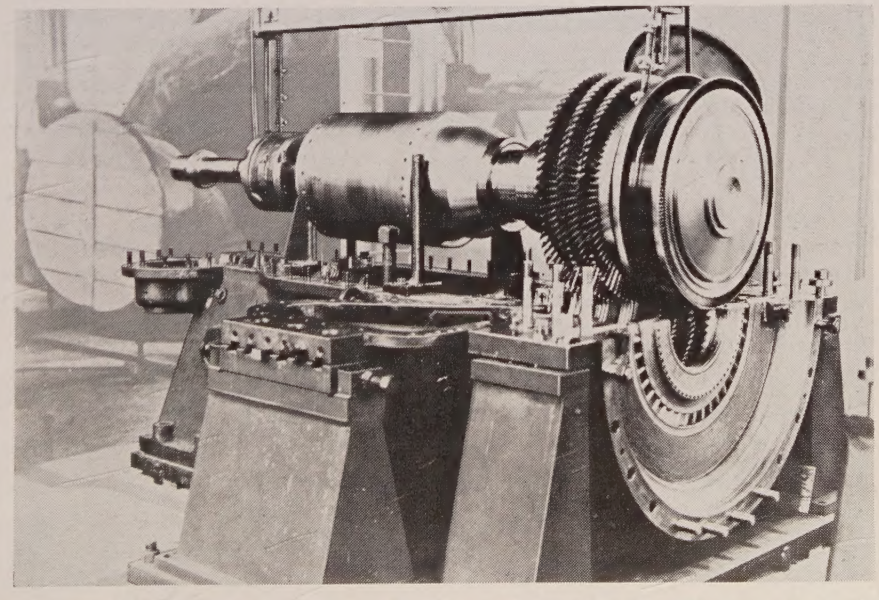
Two major applications of the gas turbine in industry have been the use in locomotives and in oil refining plants. Out of the many thousands of hours piled up by gas turbines in actual commercial operation, performance characteristics are now known. The principal commercial application has been in oil refineries, employing the Houdry process, a catalytic cracking method of manufacturing gasoline. In 1938 Allis Chalmers built units according to specifications developed by a Swiss concern, Brown Boveri, to supply large volumes of air (23,000 to 60,000 cfm) to the cracking plants. An integral part of the chemical process, their function was to furnish air pressure at lower cost than afforded by any other means.

The cross section of the gas turbine element of a Houdry unit is shown on next page. Simplicity is the distinguishing feature of the turbine, for the diverse appendages characteristic of previous types are absent. Basically the constituents are a gas turbine, compressor, combustion chamber, and fuel equipment. These are supplemented by a generator, lubrication system, control apparatus, and a means for starting.

The cross section shows a construction similar to that in a reaction steam turbine, with blades mounted on a solid rotor and in a casing. Unlike a steam turbine, however, the only control valve needed is one which the emergency governor opens at overspeed to bypass hot gas directly from the turbine inlet to exhaust. Designs may vary, but the multi stage turbine element is a basic part of any gas turbine power unit.

The second necessary part, similar to the boiler in a steam power plant, is the compressor, shown in the illustration. This schematic shows the axial flow compressor. Rotating blades like those in a reaction steam turbine, are mounted on a hollow drum and stationary blades supported in a casing. To be suitable for operation, the compressor must have efficiencies above 80%.

Air must be heated as it leaves the



A gas turbine experimental unit being assembled for high temperature tests at the Navy Experimental Station, Annapolis. (Allis Chalmers Photograph).

compressor to a temperature as high as the gas turbine blading can stand and combustion chambers similar to the one shown in part C are required. In the combustion chamber air and fuel are burned in correct mixture to bring products of combustion to a specified temperature with a negligible pressure drop between compressor and turbine inlet.

Put together, the parts comprise the gas turbine. Output power is taken up and absorbed in a generator, the propeller of a ship, or car or whatever is being driven. Efficiencies of the cycle described run in the neighborhood of 18%.

The problem of increasing thermal efficiency is one which engineers are working on hopefully. Thermal efficiency, the ratio of heat equivalents of useful output and fuel supplied in a given time, is affected by turbine inlet temperature and pressure ratio. Operation at temperatures below 1,000 F is not conducive to desirable thermal efficiencies. Previously earlier experimenters were forced to use the machine at lower temperatures because of inferior materials, with only mediocre success.

Thermal efficiency may be readily improved by introduction of a heat exchanger so that air discharged from the compressor is preheated by turbine exhaust gas. By this scheme, an effective means of developing more economical operation, is achieved. Temperatures of turbine exhaust gases are, for example, 600 F and 950 F for 1,000 F and 1,500 F cycles. Instead of discharging these high temperature gases to the atmosphere, they are used to boost the temperature of air leaving the compressor; thus less fuel is needed for each pound of air required to produce turbine inlet temperature.

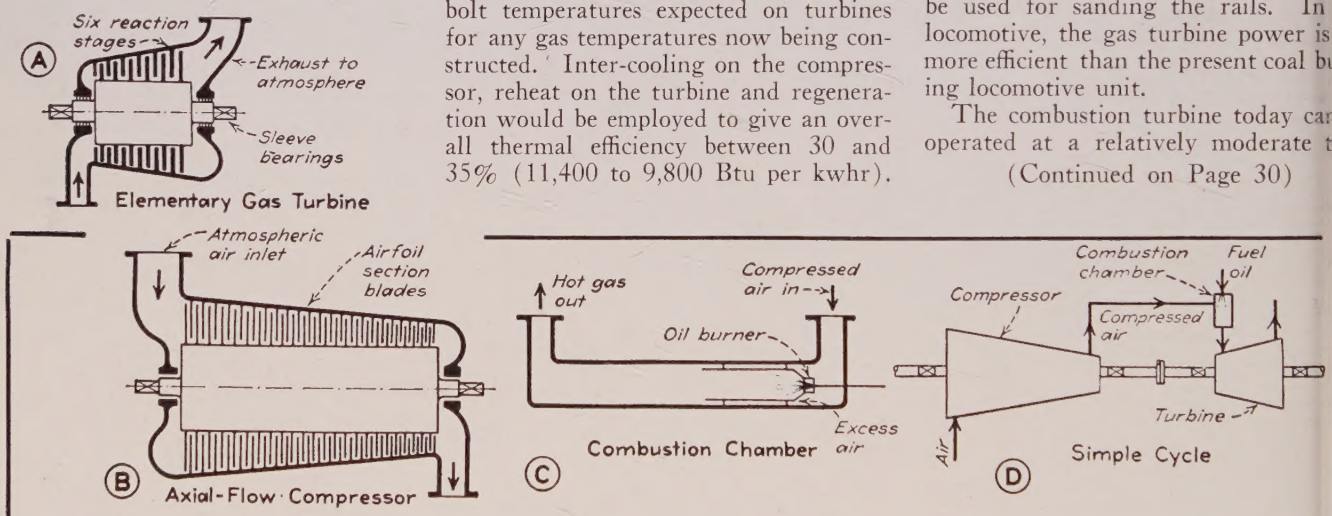
Study Gas Temperatures

During the past three years, intensive metallurgical research has resulted in data which shows that 1,200 F gas temperature can be accommodated and are practical. In the gas turbine cycle, high efficiency is more a function of temperature than of pressure (good efficiency is attained at a pressure of 60 psi). With lower pressures, stresses in the cylinder casing and bolting are kept at low level. One problem is the problem of safety. The full gas temperature is limited to inlet piping and first stage nozzle chest, parts of low stress. Because a temperature drop is taken in the first-stage nozzles, cylinder casing is subjected to a maximum temperature lower than gas temperature. Research work has progressed to a point where testing is being done on bolting at metal temperature of 1,500 F, a temperature much in excess of actual bolt temperatures expected on turbines for any gas temperatures now being constructed. Inter-cooling on the compressor, reheat on the turbine and regeneration would be employed to give an overall thermal efficiency between 30 and 35% (11,400 to 9,800 Btu per kwhr).

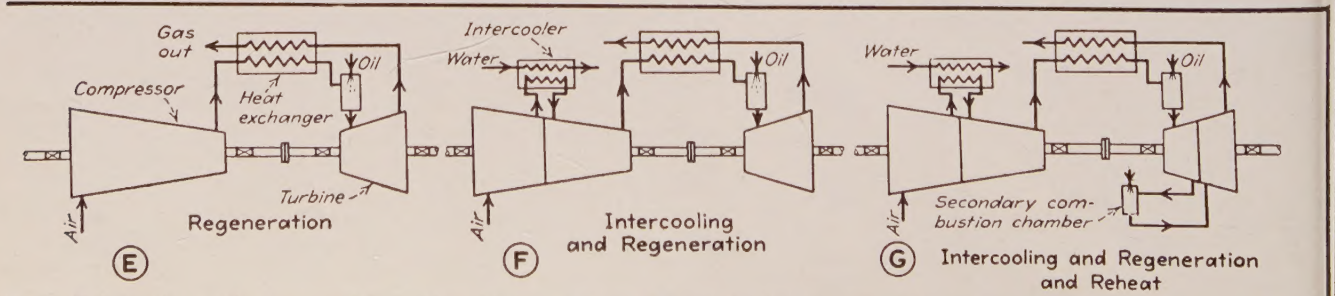
Burning of coal to power a continuous-combustion gas turbine unit has been recognized as essential if this type power unit is to have widest applicati Two main problems still confront experts: (a) controlling the burning pulverized coal under required air pr sure and (b) the effect of products combustion on blade life. In the $1,00 000 research project sponsored jointly the Baltimore and Ohio, Chesapeake a Ohio, the Louisville and Nashville, New York Central, the Pennsylvan the Norfolk and Western railroads, was found that in powder coal cert gritty impurities remained to dama parts of the turbine. The story of h success was attained is one of Americ ingenuity. The soft coal is crushed coffee bean size and then atomized high pressure cylinders. The crush coal subjected to high pressure, is sh out into normal air pressure and high pressure air trapped in the c particles in its attempt to escape sudd ly explodes the coal to microscopic fi ness. The product resembles soft, bla fluffy powder which burns instantly l gasoline or oil. Fly ash, talcum l cinders, cut the whirling blades of turbine and to eliminate it, a battery dust precipitators between combust chamber and the engine were install The ash saved by the precipitation m be used for sanding the rails. In locomotive, the gas turbine power is more efficient than the present coal bu ing locomotive unit.

The combustion turbine today can operated at a relatively moderate te

(Continued on Page 30)



Basic gas-turbine unit is an assembly of multi-stage reaction turbine *A*, multi-stage axial-flow compressor *B*, and elongated cylindrical combustion chamber *C*. For simplicity, these elements are represented schematically as in *D*



Fuel efficiency is greatly improved by adding heat exchanger *E*, still further benefited by intercooling between stages of compressor *F*, and can well borrow the advantages of reheat from steam cycle by direct oil firing *G*

The Engineering Honoraries and Societies

The main purpose of engineering honor societies is the recognition and encouragement of students who have excellent college scholastic records and personal attributes which indicate future success in engineering. Illinois is proud to say that many of the honoraries with chapters in Universities throughout the country were founded here. The aspirations of the young men who banded together continued to live as the societies grew. Here is a brief history of the campus honoraries.

TAU BETA PI

le history of Tau Beta Pi, since its ding in 1885 by Edward Higginson ams, Jr., has been one of constant sion. From its beginning at Lehigh university it has grown to its present size of 79 active chapters.

The fraternity was conceived to recognize those who confer honor upon their Alma Mater by distinguished scholarship in undergraduate work, or by their achievements as alumni in ield of engineering; and to foster rit of liberal culture in the engi- ng colleges of America.

au Beta Pi was one of the six orig- members of the Association of Col- Honor Societies, formed in 1925 result of endeavors to clarify the tion regarding honor societies.

1897 Illinois Alpha became the chapter founded. Today its mem- ip includes 18 undergraduates, over faculty men, and numerous gradu- students. The officers for the fall of the school years are Arthur J. inger, president; Wayne A. Ring, president; Lawrence J. Breinin, sponding secretary; MacDonald L. derson, recording secretary; and iam P. Meyers, treasurer.

SIGMA TAU

the fall of 1903 a group of civil neering students at the University Nebraska met with the purpose of nizing a new engineering society.

After two or three meetings it was decided to invite other engineers into the group. With a group of 14 men, weekly meetings were held and the details of the organization were worked out. The formal found- of Sigma Tau took place at a ban- held at Lincoln, Nebraska, on uary 22, 1904.

he men who organized Sigma Tau not at that time realize that within mparatively few weeks the frater- would attain nationwide promin- and recognition. It is to their it that plans originally made for a society should be so well conceived they could serve, almost without a ge, as a basis for a national fraternity. For the first four years national expansion was discouraged. These years were spent in strengthening of Alpha Chapter. In 1908 Beta Chapter was established. The National Council met in 1912 and from that time on the history of the fraternity was one of constant expansion. At present there are 25 active chapters.

The main purpose of Sigma Tau is to be of service to engineering education in the institutions where chapters exist. This is accomplished in different ways: first, by the participation of its members in the advancement of engineering activities and second, and most important, by encouraging study to attain the standards necessary for membership in an honorary society.

Qualifications for election to Sigma Tau may be most briefly described by the words scholarship, practicallity, and sociability. The procedure established is intended to safeguard the quality of the membership as far as possible. The results have shown these methods of election to be very adequate, for since its founding its members have advanced Sigma Tau to a place among the leaders of professional societies.

ETA KAPPA NU

Eta Kappa Nu was first conceived in the mind of Maurice L. Carr early in the school year of 1904-05. He banded together with him nine men who were fellow students at the University of Illinois and on October 28, 1904, at Urbana, Alpha chapter was formed.

The society was composed of men who had chosen electrical engineering as their life work and its purpose was to inspire them in their common aims and pursuits and to do all in its power to benefit the profession in general.

Each undergraduate chapter and each alumni chapter is carrying out these ideals in the manner best fitted to its individual needs. A national organization, elected by the chapters, exercises general supervision and correlates the efforts of the individual chapters. A bi-monthly magazine known as the "Bridge" keeps the members informed of the organization's activities and forms a means of contact between graduates and undergraduates.

Membership is offered to men in their junior or senior years who have acquired outstanding records in their study of electrical engineering. Other requirements are good character, personality, and appearance.

One of the things that has been accomplished by the undergraduates and alumni of Eta Kappa Nu is that each college chapter is expected to conduct an organized search under the direction of the faculty member in charge of placement activities for information which will help locate positions for all electrical engineering seniors. Practically all alumni chapters have employment committees to aid members in securing positions and to help those employed to better themselves.

Besides the membership qualification, which in itself encourages high scholarship, practically every chapter awards a prize to the E.E. student with the highest average at the end of his freshman or sophomore year.

Eta Kappa Nu members recognize that progress in their profession must be paralleled by a steady growth of the A.I.E.E. and I.R.E. and are cooperating with industry's professional societies to the utmost. The alumni aid student branches and are active in A.I.E.E. committee work.

Since its founding in 1904 the society has grown from the original chapter to 38 undergraduate chapters and alumni chapters in many of our large industrial cities.

Alpha chapter is proud not to have been another war casualty. It was pulled through the war years principally by Navy trainees stationed on the campus. Now with the return to peacetime

(Continued on Page 18)

The University of Illinois, Illinois Central dynamometer car

University of Illinois

RAILROAD DYNAMOMETER CAR

By A. R. WILDHAGEN, Dept. of Public Relations

Forty-eight years ago the University of Illinois and the Peoria and Eastern Railway, now a part of the New York Central system, built the first railroad dynamometer car to use an oil pressure cylinder connected to the drawbar to give a sensitive direct measure of the pull being exerted by an engine coupled in front of the car against resistance of a train coupled behind the car. This car, built in 1898, was one of the first 10 dynamometer cars in America. Another of the first 10 was the similarly constructed hydraulic-type car, the second of its kind, built in 1900, jointly by the University and the Illinois Central railroad.

With these cars much has been accomplished by the University both in research and in student training. Basic data has been gathered about train and car resistance and tonnage ratings, data which has been widely applied on American railroads with important economic effects. The car owned by the University with the Illinois Central was altered in 1907 and again in 1937, and in 1943 was replaced by a sleek new streamlined car completed in 1944, which today is the newest equipment of its kind on American railroads.

Mystery of Car 609

What happened to number 609, the car owned with the Peoria and Eastern, is a mystery. In November, 1901, both the P. & E. and the I. C. cars were listed and discussed in a talk prepared by Prof. E. C. Schmidt of the University for the Pacific Coast Railway club at San Francisco. The P. & E. at that time was leased by the Chicago, Cleveland, Cincinnati, and St. Louis (Big Four). Since then its status has changed, and now the road is operated by the New York Central. The transfer of records at the time the road's status changed in 1923 contained no mention of car 609, and University records are equally blank. The car is said to have been stripped of test equipment early in the 1900's and returned to service as a caboose.

The University developed the first dynamometer car to measure the pull of locomotives, tonnage ratings and car resistance. Data gathered during the past 48 years has been widely applied by American railroads.

Professor Schmidt in his paper said that the first dynamometer car in America appeared to have been built in 1874, and that at the end of 1901 there were 10 cars on this continent and six abroad. He listed the cars in America in order as: Erie railroad; P. H. Dudley; Pennsylvania railroad; Chicago, Burlington, and Quincy railroad; Chicago and Northwestern railroad; Canadian Pacific railroad; Chicago, Milwaukee, and St. Paul railroad; Peoria and Eastern railway (C. C. C. & St. L. lessee) a the University of Illinois; Illinois C tral railroad and the University of I nois; and Great Western railroad.

He said that all of these, except th of the University and of the Burling were of the spring type, utilizing formation of springs connected to drawbar to measure the pull of the gine, and that the Burlington's car just been redesigned "within the last months" into the same oil-cylin measurement type as the Universi cars.

Two Cars Used

Both mechanical and hydraulic ty of dynamometer cars are in use too The present University of Illinois Illinois Central car, like its predeces is of the hydraulic type, measuring engine pull by the pressure of oil wit a cylinder in which a moving pisto connected to the drawbar. This eq ment is so sensitive that it will indi the force exerted by a man pulling the drawbar, yet strong enough measure the pull on a train of 25 senger coaches or of 200 freight car

Statements made by Professor Schm 46 years ago still hold true. "The ca he said then, "were built by the railr and equipped by the University, and erated for the advantage and infor tion of both. The car is considered the University as a part of its laborat equipment, and affords facilities for n

(Continued on Page 28)

New Instruments for the U. of I. Test Car

by Jerry Mathews

...ne dynamometer test car, owned ...y by the University of Illinois and ...llinois Central Railway, is used as ...xperimental car by the University ...performance testing under various ...itions and in turn the information ...red is employed by I. C. for new ...opments.

...st cars used by the University of ...is have seen many years of service, ...irst being built in 1900, but new ...opments and different designs have ...pletely altered the original. A new ...was built in 1943, and some of the ... instruments used in connection ... it are a good example of modern ...tific influence.

...water meter, for one, designed by ...essor John K. Tuthill of the elec... engineering department, indicates ... of water into the boiler. It is a ... device similar to a water turbine, ...h turns on an axle as water flows ...ugh the meter. The axle, by turn... rotates a cam, which opens and ... an electrical circuit and eventually ...ds the rate of flow on a continuous ... of paper by means of a recording ...located in the cab. The recording ... connected electrically through a ...netic circuit, indicates a small blip ... certain number of gallons. The ...nuous paper, being turned at a de... rate, provides a means for record... the rate of flow.

...his entire instrument was produced ... at the University. Designed by ...essor Tuthill, the pattern and cast... were made by George Powers of the ... shop, and the wiring was done by ...est crew. Other water meters have ... in use of course, but for the most ... they are cumbersome and inaccu... for all conditions.

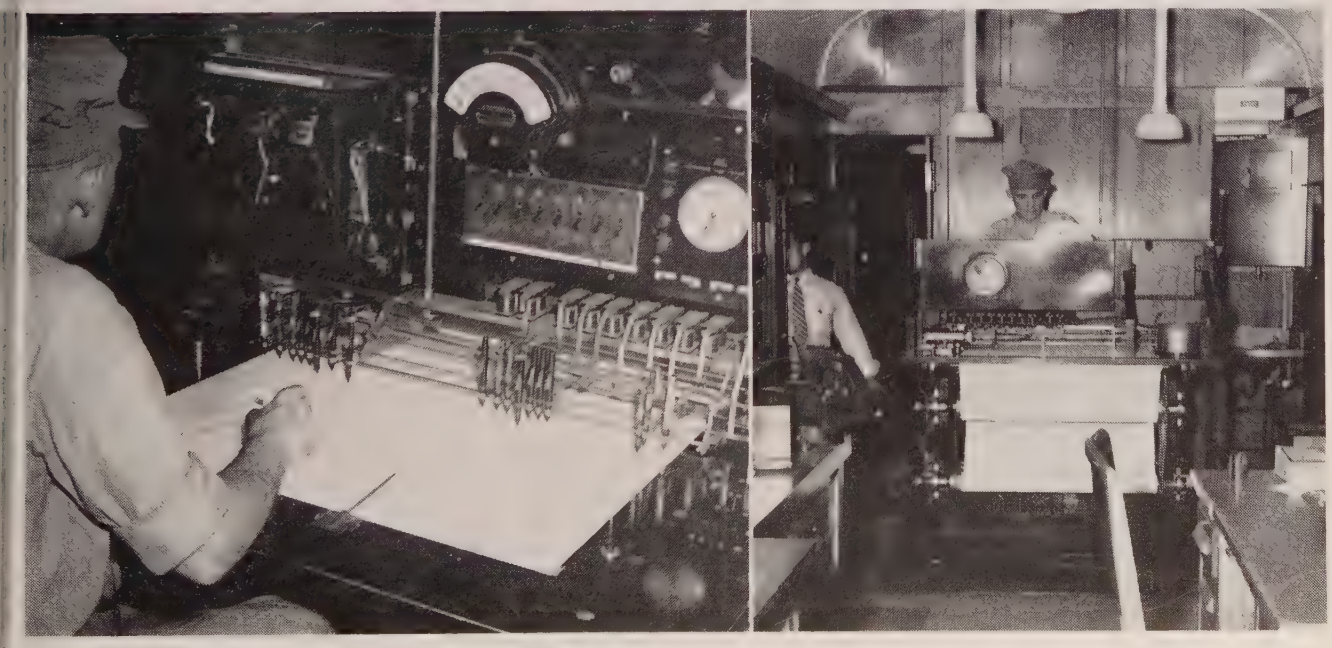
With electrical connections, a water meter can be used accurately for hot and cold water without affecting its operation, and the continuous record can be shown in a convenient place. This instrument serves an important use on cars in operation as well as on test cars. For instance, it would be handy for the fireman to know if he is getting water into his boiler, especially with a huge, blazing fire in the fire box, for it has been proven that sight glasses can scale up and give false readings. Two famous codes for firemen are "Don't light a boiler off a hot brick wall" and "Don't light a boiler 'wid no' water in it."

Selsyn Principles

Three other instruments, slightly more complicated than the water meter indicator, are lumped into one face, representing what looks like a gas meter on the outside. Actually the insides are a maze of wires which connect to pronged terminals, making the back resemble a radio tube. These three instruments, water level indicator, valve position indicator, and throttle indicator, all operate on the selsyn principle and are fairly recent developments (after Pearl Harbor). They are used quite widely in aircraft, especially on military aircraft, for slightly different purposes. An instrument similar to the water indicator is used in airplanes as a fuel level indicator while the same principle is applied to show position of landing gears. Other applications include rudder angle indicator, gyro compass repeater sets, and steering gear motors for ships. When used to indicate valve positions this type of instrument has proved useful in detecting a valve which tends to vibrate open or shut, its position being recorded on paper continuously.

The recent development of the selsyn unit, although an old idea, is probably due to a need in modern electronic instruments for transmitting, by electrical means, a signal which represents angular position. The selsyn (self synchronous) is a very simple and efficient method of transmitting angular positions. The operation is based on the principle shown, which is G. E.'s schematic diagram and

(Continued on Page 26)



Top of recording apparatus showing recording pens, moving paper chart and operator making notes. (Right) interior of dynamometer car. Records are kept on paper tape.

Featuring Faculty . . .

by Barbara Schmidt and Ed Witort

PROF. E. W. LEHMANN

The creed which Prof. E. W. Lehmann prescribes for agricultural engineers is perhaps best applied as a key to the character and accomplishments of Professor Lehmann himself: "to improve working conditions, improve the quality of the product, improve labor efficiency and increase output per person, and (to) make possible more real income and a higher standard of living for the farm worker."

Throughout an active career of study and of productive effort in the field of agricultural engineering, Professor Lehmann's work bears the stamp of learning, of enthusiasm, and of extreme and diverse capabilities. He is listed in the current issue of *Who's Who in America*, and in past years, he has been cited in leading magazine and papers throughout the Middle West for his outstanding work in the field of agricultural engineering.

Professor Lehmann received successively a B.S. degree in electrical engineering from the Mississippi State college, a professional degree in E.E. from the Texas Agricultural and Mechanical college, a B.S. degree in agricultural engineering at Iowa State college, and a professional degree as agricultural engineer from the same school. During the period of study which resulted in the above listed degrees, he attended Cornell university and the University of Wisconsin for special work and served as physics instructor at Texas A. & M. college.

Professor Lehmann later served as instructor and assistant professor in agricultural engineering at Iowa State college. He also served on the faculty at the University of Missouri as associate professor, professor, and head of the department of agricultural engineering. After a short term as agricultural engineering editor of *Successful Farming* magazine, Professor Lehmann came to the University in 1921 and has been head of the department of agricultural engineering here since that time.

During Professor Lehmann's earlier years with the University, he along with his associates developed new courses, organized the agricultural engineering curriculum, and developed a program of research and extension. This work has gone forward, and many projects relating to farm power and machinery, farm

PROF. E. W. LEHMANN

structures, soil conservation, and rural electrification have been developed. Professor Lehmann is especially interested in rural electrification, home utilities, and soil erosion control. He has written many articles on these subjects for various farm journals and magazines, and he was instrumental in bringing about the first use of terraces in erosion control in the Middle West as an extension project.

In 1933 Professor Lehmann acted as adviser with the C.C.C. soil erosion camps in Illinois; in 1934 he was given an appointment as a cooperative agent in Soil Erosion service by the U. S. Department of the Interior. In 1935 he was appointed drainage engineer and collaborator for C.C.C. drainage camps in Illinois by the U. S. Department of Agriculture. He has served as a member of the State Rural Electrification committee since it was first organized. Professor Lehmann has given numerous reports, radio talks, and addresses on other phases of agricultural engineering such as home improvement, farm power and machinery, and drainage.

Professor Lehmann has conducted research on the problem of sewage disposal for the isolated home and is co-author of a bulletin which is used as a basis for design. In the study of the problem of harvesting soybeans, he was largely responsible for having the first combine harvester brought to Illinois. Through this method of harvesting the soybean crop, the losses were reduced from about 35 per cent to less than 8 per cent, making the production of the crop practical.

Professor Lehmann is an ardent p
moter of safety on the farm as sho
by his many discussions and demonst
tions on safety throughout the state a
his work as chairman of numerous saf
committees, including the State Saf
committee and the First National Fa
Safety week, and a member of the ag
cultural committee of the National Sa
ty Council.

At present Professor Lehmann is
pervising research work on the relati
ships of power, machinery, and la
and a research project on rural elec
fication in cooperation with the Pub
Service Company of Northern Illini
Both of these projects should prove
be of great benefit to the farmer
they will assist him in getting elec
service and will give him valuable in
mation on some new methods of red
ing labor in farming.

Professor Lehmann's interest in
field of agricultural engineering
brought him into contact with m
professional societies and other grou
In 1922 he was president of the Am
can Society of Agricultural Engine
and has been active in that society si
then. He has served as a member
the A.S.A.E. advisory committee for
Museum of Science and Industry
Chicago, the Farm Structures comm
tee on Farm Sanitation, and the c
mittee on Industry Seminar. He
been associated with the Joint comm
tee with the U. S. Public Health S
ice on Farm Sanitation, the Soil Ero
committee, and served on the advis
committee of the U. S. Departmen
Agriculture which meets in Washing
each year to consider problems of c
mon interest to federal and state a
cultural engineering divisions. In 1
he was a member of the committee
farm and village housing of the P
dent's Conference on Home Build
and Home Ownership.

In 1928 Professor Lehmann was
leave of absence from the Univer
and developed a program of rural e
trification for one of the state po
companies. In 1938, while on leave
absence again, he inspected 40 s
colleges and experiment stat
throughout the country. More rece
he served on the Occupational Advi
committee of the Children's Bureau
the U. S. Department of Labor.
fessor Lehmann is also a member of
American Society of Engineering E
cation and is active in the Illinois
ciety of Professional Engineers.

Professor Lehmann is Presbyte
a member of Rotary and Acacia, a c
ter member of the Illini Quarter
club, and a member of Alpha Z
Alpha Tau Alpha, Gamma Sigma
ta, Phi Kappa Phi, and Sigma Xi.

(Continued on Page 20)

What kind of engineer does the Telephone Business need?

Many kinds, for many kinds of work . . . research and development, technical and economic planning, operations which involve the manufacturing, construction and maintenance of telephone facilities.

Telephone engineering is broad in scope but includes intensive study of a wide variety of specific problems. Much of it requires the special knowledge of electrical, mechanical, industrial or other engineers. All of it requires the engineer's background, his understanding of scientific principles, his trait of weighing the facts and deriving logical and workable conclusions.

With our greatest expansion program in history under way the work of the telephone engineer is more important than ever. In the next few years $2,000,000,000 will be spent for new buildings, new equipment and plant facilities.

The engineering task involved in this program, as well as in the normal operation of the industry, means just one thing: qualified engineers who choose telephony as a career will find their lives packed with interesting and satisfying work.

There's Opportunity and Adventure in Telephony

BELL TELEPHONE SYSTEM

Bell Telephone Company

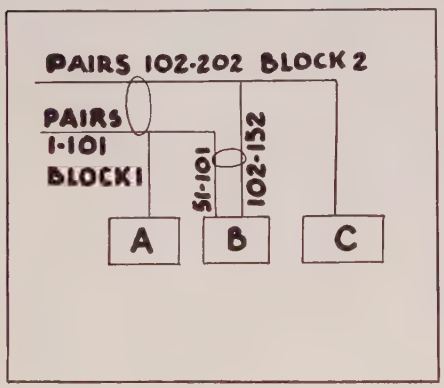
Serves the University

by Jim Becker

The author wishes to express his appreciation to Mr. J. W. Wolcott of the Illinois Bell Telephone company for his collaboration in the writing of this article.

On December 14th of this year, the University replaced its former independent telephone system with one installed by the Illinois Bell Telephone company. For the company, this date marked the successful culmination of long-time efforts urging the adoption of its services.

The first University exchange was installed in 1903 and remained in operation until 1936. In 1934, however, the obsolescence of the old system was recognized and University officials entertained bids from several manufacturers of telephone equipment as well as a proposal of services from Illinois Bell. At the time, it was considered more favorable to install an independent exchange to be handled by the University and, as a result, the equipment essential for such a system was purchased and placed in



operation in October of 1936. This new exchange carried provisions for approximately 1,100 telephones to handle communications for the entire University and was more than adequate at its time of installation. However, the rapid expansion of facilities and staff, occasioned by the advent of the war, necessitated a large increase in telephone service. Consequently, the available surplus of lines was soon absorbed and it became necessary to increase the number of stations operating on a single line. In some offices there were as many as 19 telephones functioning on what was originally a one-party line.

Again it became apparent that major additions of cable and switchboard were inevitable and, accordingly, it was decided to have the Illinois Bell Telephone company furnish all of the telephone service on the campus. The actual installation work on the system, begun in August of this year, consisted of three major divisions; cable laying and splicing, installation of the exchange, and installation of the equipment, this latter covering the telephones themselves and the myriad of auxiliary keys, lamps, signals and other devices which tend to make the service more flexible and satisfactory to use.

The first of these comprised the main outdoor work. There were two possible paths along which the cable could have been laid; through the pipe tunnels of the University heating plant or in trenches dug for the purpose. The first of these was not feasible, due to the fact that the high voltage line supplying power to the University also followed the tunnels. Consequently, the second path was chosen and some five miles of trenches, approximately two feet deep, were excavated by the Physical Plant of the University.

The campus was split into two main areas to be fed by different sized cables. That area north of the Illini Union building was served by a cable comprising 900 pairs of wire, while the area to the south was fed by two cables, one of 1,500 and one of 1,200 pairs. Passages under streets and sidewalks were made possible through the use of a hydraulic ram which was employed to push a three inch capped pipe under the obstructions. After removal of the cap, a tow cable was passed through the pipe. The pipe itself was then removed, and the tow cable attached to the main cable which was then pulled through the hole left after the removal of the pipe.

The pairs of wire in each cable were split into blocks of 100, each block of 100 being coded to facilitate identification. The 1,500 pair cable, for example, contained 15 blocks of 100 pairs each. The pairs in each block were numbered consecutively. Thus the first block contained pairs 1-101 inclusive, the second block, 102-202, and so on. A multiple feed system, as illustrated below, was used. Consider three buildings, A, B, and C, fed by two blocks containing

Typical splicing operation

pairs 1-101 and 102-202. From the block, pairs 1-101 are fed to building and from the second block pairs 102- are fed to building C. In addition, p 51-101 from the first block and p 102-152 from the second block e building B. This results in the di bution shown in the figure. This di bution provides 100 pairs for each bu ing, but, because of overlapping, onl of these are available for one-party s ice. The remaining pairs may be ployed for two-party service. The a explanation assumes that each buil has an equal demand and that the sy is operating at full capacity. Th not, however, the general case and therefore, possible for building A, example, to employ 100 pairs for party service providing that buildi does not utilize pairs 51-101. Th highly flexible system utilizing the imum amount of cable is available.

At each building the feeder c were spliced into the house cables, establishing a system of direct feede that a telephone on the fourth floo a building, for instance, is cabled d to the Union building without an termediate junction point. Fig. 2 i trates the typical splicing operation. ends of each pair were stripped of insulation for a distance of three in twisted tightly together, and neatly ered with an insulating sleeve to pre short circuits. Upon completion of phase of the operation, the pairs sprinkled with a dessicant to a moisture and wrapped in muslin. A sleeve was then slid over the muslin joined to the cable sheath at either by a "wiped" joint. (See Fig. 3) insure a water tight joint, a small was drilled through the lead sleeve nitrogen gas applied through this under pressure. From previous test

(Continued on Page 22)

RCA Victor "Eye Witness" television receiver shown above, gives you 52 square inches of picture brilliance.

A referee's eye view of every play – by Television!

u feel as though you were right there at e game—when you see it through RCA's illiant television.

Football fans as far as 250 miles away m the stadium have enjoyed watching ny of the big games this fall through BC telecasts. And football fans become evision fans when they see how closely e camera follows the ball.

At the game, the sensitive RCA Image thicon television camera sees every line unge, kick, pass and run. It may be a udy day or the sun may go down but u still enjoy the *bright sharpness* of the CA Image Orthicon camera.

On the screen of your RCA Victor home television receiver none of that bright sharpness is lost.

For after you've tuned in the game, the new RCA Victor "Eye Witness" Picture Synchronizer automatically "locks" the picture in tune with the sending station—eliminates any distortion—assures you of *clearer, steadier* pictures.

For television at its best, as pioneered at RCA Laboratories, you'll want the receiver that features the most famous name in television today—RCA Victor.

• • •

Radio Corporation of America, RCA Building, Radio City, New York 20, N. Y.

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RCA **RADIO CORPORATION of AMERICA**

ARTHUR LEININGER
Editor

•

HOWARD FRANKLIN
Associate Editor

Illinois Technograph

Experience with Practical Problems

In the past, student engineers have been passing up many excellent opportunities to make practical applications of the knowledge they are attaining in college. One complaint heard from many students is that they do not acquire enough practical information along with their theoretical studies. More practical work in courses is not offered because it is thought that if a more complete knowledge of the theoretical aspects is obtained, the know-how will easily follow after graduation. However, a person desiring the practical experience can get it here at the University if he so desires.

In everyday living, there arise many problems, both large and small, whose solutions are fundamentally the same regardless of whether they pertain to engineering or not. The logic behind the solution of any problem is reasonably simple provided a few basic principles are followed. The first step in the solution of any problem, of course, is to become thoroughly familiar with the conditions of the problem. After attaining this familiarity, the various factors should be roughly classified into known and unknown groups which should, in turn, each be subdivided into variable and fixed quantities. When the conditions of the problem have all been worked out, the real work of studying each factor and its dependence or relationship to the other factors begins. In mathematical problems, where the factors are fairly well defined, a single solution to any given problem is frequently possible. Also many of the simpler problems of engineering point towards a single, outstanding solution; however, in the more complex problems arising out of everyday living, of which engineering comprises only a small portion, the conditions of the problem are so numerous and so interdependent upon each other that any number of perfectly good solutions may be apparent. Whether or not one of these answers happens to be better than the rest depends entirely upon the conditions of that particular problem.

It is certainly true that no individual or organization is perfect and there is always plenty of room for improvement. For the student desiring to obtain a little practical application in the art of solving problems, there is no time like the present to begin. If a student sees some situation here at school that he feels could bear improving, he can attack the problem to see if he can find a better answer.

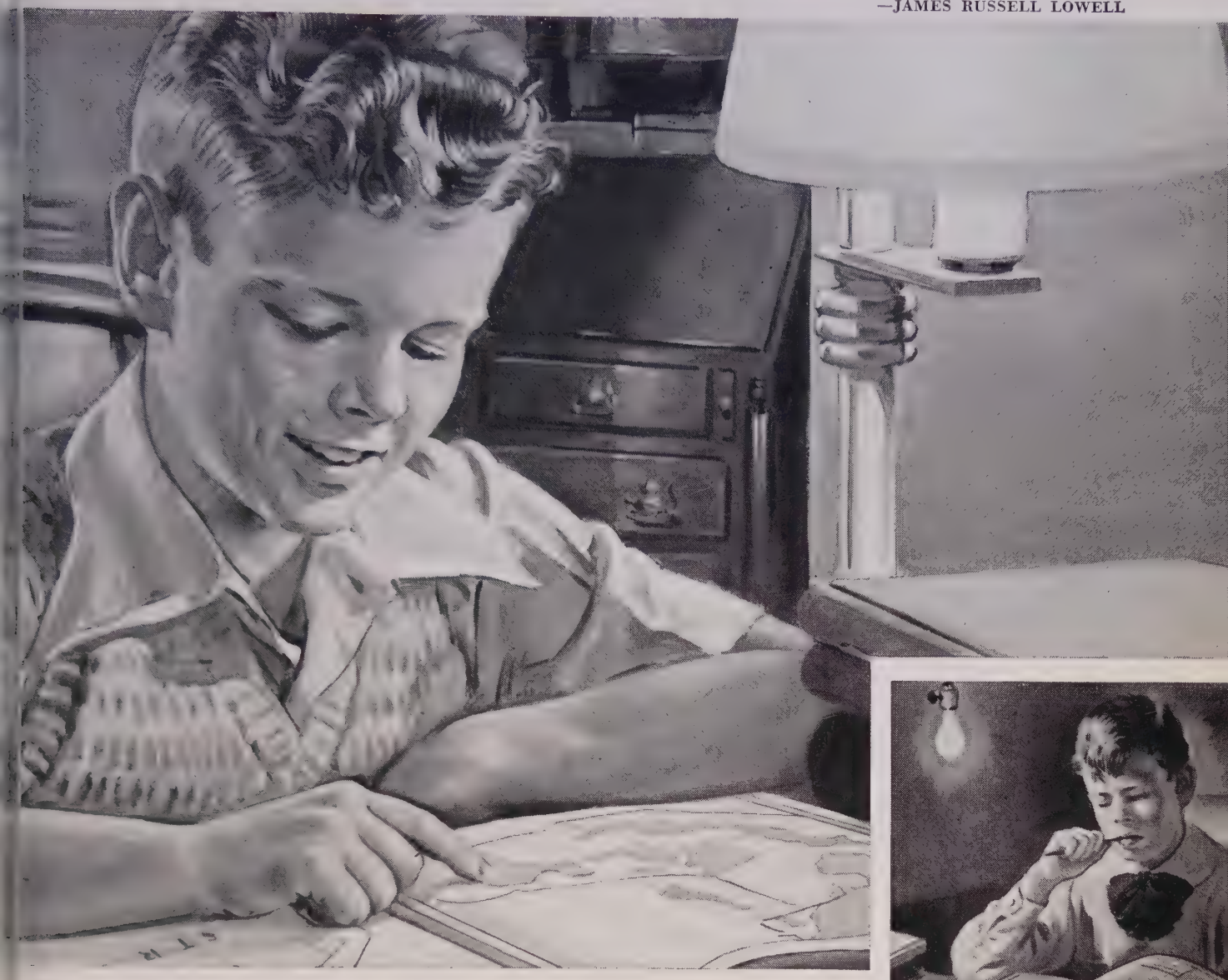
For example, some of the students in civil engineering are making a study of the traffic conditions at the University. As everyone knows, Green street has very heavy traffic; and, with the large number of bicycles now on campus, there is a definite factor of danger for both the motorist and bicyclist. This, of course, includes the pedestrian; but, in addition, there is also the problem of merely getting across the street.

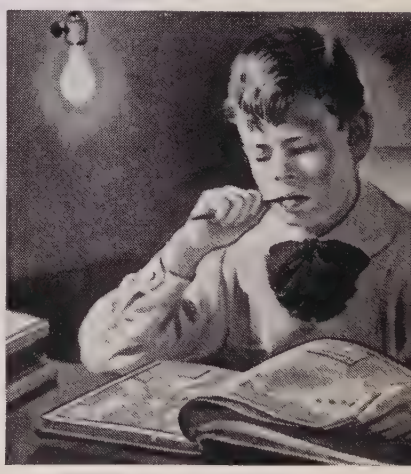
There are problems in other fields of engineering which the student, either individually or as a group, can tackle with the idea of finding a practical solution. Of course, he may and probably will come up with the wrong answers the first few times; but at least he will be gaining invaluable experience provided that he studies the wrong answers in order to find out where he slipped up and what he can do to correct his method.

Therefore, if you are one of the persons who feels that you have not been getting enough practical experience while in college, why not tackle some real problems and see what you can do with them?

is not the finding of a thing, but the making something out of it after it is found, that is of consequence"

—JAMES RUSSELL LOWELL





hy some things get better all the time

KE THE MODERN ELECTRIC LIGHT BULB, for exple. Its parts were born in heat as high as 6,000° F. in cold as low as 300° below zero . . . under crushpressure as great as 3,000 pounds per square inch. Only in these extremes of heat, cold and pressure nature yield the metal tungsten for the shining ment . . . argon, the colorless gas that fills the bulb and the plastic that permanently seals the glass to the metal stem. And it is because of such materials that light bulbs today are better than ever before.

The steady improvement of the electric light bulb is another inace of history repeating itself. For man has always l to have better materials before he could make ter things.

Producing better materials for the use of industry and the benefit of mankind is the work of Union Carbide.

Basic knowledge and persistent research are required, particularly in the fields of science and engineering. Working with extremes of heat and cold, and with vacuums and great pressures, Units of UCC now separate or combine nearly one-half of the many elements of the earth.

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INDUSTRIAL GASES AND CARBIDE

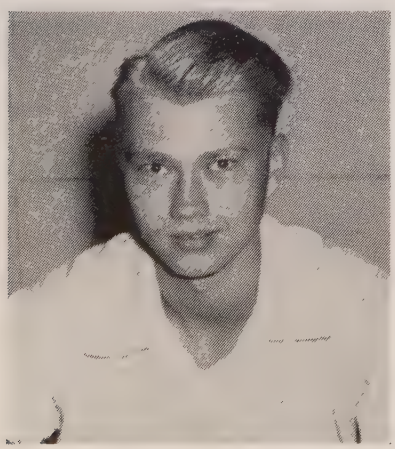
Campus Contemporaries . . .

by Dorothy Collier and Jim Leeming

WAYNE RING

"South hole, this is Mole speaking." A telephone has just been installed in the south basement of the Men's Residence Hall. One of the many "moles" is mechanical engineering student Wayne Ring. Hailing from Rockford, Illinois, Wayne attended East Rockford high school and for three years was a member of its varsity golf team. Incidentally, during these three years the team was state champion twice. While at Rockford, Wayne took up the violin and since has turned into quite a musician.

On March 1, 1944, Wayne entered the Navy. Under V-12 he was sent to Notre Dame for two semesters and then to the University of Illinois for seven more. While studying here at Illinois, Wayne didn't have much time to devote to the violin. This isn't hard to understand when you consider that he made straight A's in freshman math. However, if you were here for the Christmas "Jinx" Show given by the V-12 students in December, 1945, you may remember his playing. The captain of the V-12 unit here was also somewhat of a violinist. Wayne first played a Jack Benny take-off of the captain, but is still wondering if the audience was aware of the fact that during the last part of the act he was playing as Wayne Ring. Also while stationed here, Wayne



WAYNE RING

played two years on the Illinois golf squad. A well deserved rest came with his discharge after seven straight semesters of study at Illinois.

While following a mechanical engineering course, Wayne devotes time to A.S.M.E., has served as president of Pi Tau Sigma, vice president of Sigma Tau, and vice president of Tau Beta Pi. Between studies and activities he can usually be found down at the aforementioned "south hole" with 38 or more of his roommates. An orderly discussion may be in progress but more often it's just a discussion.

Wayne spent the summer in a drafting room working on designs of domestic water softeners. After graduation he hopes to hold a similar job and gain all around experience in the engineering field.

RALPH HOECKELMAN

Guitar-plunking Ralph Hoeckelman became a chemical engineer because as a child he was denied the chemistry set that he longed for Santa Claus to bring. With gradaution in January he will

RALPH HOECKELMAN

have reached his goal of a B.S. in chemical engineering.

In the trivia department, Ralph says that women are not his headline interest. Rather than discussing faces and figures of Illini coeds, he pointed out an interesting fact about women's appetites. In his opinion women either eat too much or too little. The "Flying Dutchman," as his friends call him, speaks from experience as he is an ex-KD waiter. Women must have been too much for him. Now he is serving at Chi Phi fraternity.

Ralph came to Illinois from Quincy, Illinois, because he knew of the good reputation of the College of Engineering, and evidently he had heard the song "and for good fellows—Illinois." A former member of the Tech staff, Ra is also a member of A.I.Ch.E.

Ralph is six feet tall and 23 ye of age. He has no definite plans for future at present but would like a dealing with synthetics.

For leisure time activities, either game of tennis or handball followed a big steak dinner marks the end o perfect day for Ralph.

ENGINEERING SOCIETIES .

activities, Alpha is looking forward a future even more successful and o standing than its past has been. T present officers are Arthur J. Leining president; Jay A. Cox, vice preside William E. Shoulders, secretary; a Herman E. Koenig, treasurer.

PI TAU SIGMA

Pi Tau Sigma is a national mech ical engineering honorary fraternity. was founded in 1915 at the Univers of Illinois with the object of foster the high ideals of the en neering profession, to stim late interest in co-ordin departmental activities to promote the mutual p fessional welfare of its me bers. It strives to estab a closer bond of fellows which will result in mutual benefit those men in the study and in the p fession of mechanical engineering, w by their academic or practical achie ments, manifest a real interest marked ability in their chosen work.

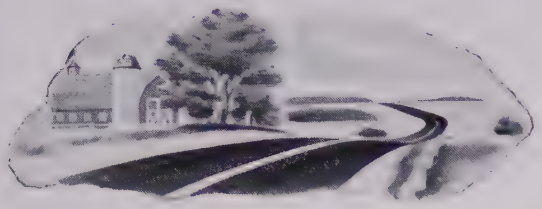
Members are honorary, active, graduate. Honorary members are professional engineers either in prac or teaching who have merited the spect of their fellows. Graduate m bers are those, formerly actives, v are in graduate work. Active memb are chosen each semester from the j ior and senior mechanical enginee classes on the basis of sound enginee ability, scholarship and persona Qualities which are expected of m bers are leadership, personality, tr worthiness, industry, dependability, promise of future success in Mecha Engineering. Candidates are sele with reference to social adaptabi honesty, personal cleanliness and m ness, and soundness of principles morals.

The fraternity endeavors to pro scholarship, develop social values in profession, and uphold the standard engineering practice in general. It c erates with the American Society Mechanical Engineers and the o engineering honoraries toward t ends.

The officers for the fall semester

(Continued on Page 22)

You saw us today . . . remember?



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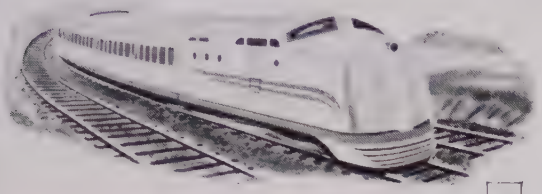
When you crossed the road and saw that orchard . . .



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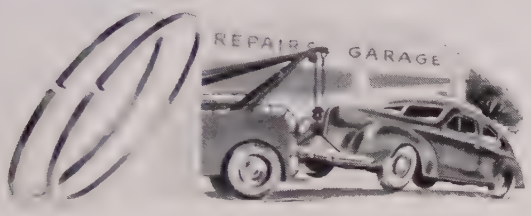
or watched the train . . . or bought a new dress . . .



5

6

left your car for repair . . . or ordered roofing . . .

7

8

or took your vitamins . . . or made a phone call . . .

9

you saw a Koppers product in use

1. Tarmac. **2.** Flotation Sulfur Sprays. **3.** Pressure-treated cross ties. **4.** Chemicals for dye intermediates. **5.** Piston rings. **6.** Roofing. **7.** Chemicals for pharmaceuticals. **8.** Chemicals for molded plastics. **9.** Coke plants. All these are Koppers products . . . and many others that touch your welfare in countless ways. The Koppers trademark is the symbol of a many-sided service. Wherever you see it, it means top-notch quality. Koppers Co., Inc., Pittsburgh 19, Pa.

K

KOPPERS

Featuring Faculty . . .

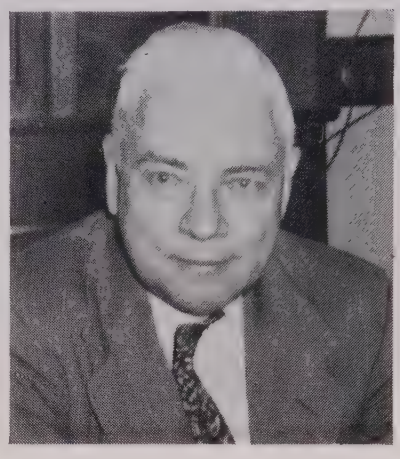
PROFESSOR DOLAND

Another good man back on the faculty teaching staff is Prof. James J. Doland of the Civil Engineering department. For three and one-half years he was supervising engineer of the organization and construction of the recently completed Illini airport. Back in the good old days he was known as Jimmy Doland and used to be a target of the now extinct "Bucket and Shovel" column of the *Technograph*. At the time he was already faculty adviser of this publication and continued to hold this position until late in 1937.

His first appearance into the world was in Denver, Colorado, where he stayed to complete his junior education. Upon graduation from high school, he spent several years doing engineering work for the U. S. Reclamation Service and for the former Hay company, general contractors of St. Paul, Minnesota. During World War I, he was a first lieutenant in the Construction Division Army at Nitro, West Virginia, where he was in charge of water supply purification and distribution.

After the war, he mined coal in Missouri. That is to say, he was in charge of strip mining there. Upon receiving his C.E. from the University of Colorado at Boulder, he came here to work on his M.S., which he received in 1932.

Until 1942, Professor Doland found that his teaching duties left him with



PROF. J. J. DOLAND

time on his hands, and so he did something about it. Golf did not appeal to him, so he became a member of the National Research Planning board, private consultant for a railroad power company, water consultant the upper Mississippi and Ohio ri basins, and star witness for the U. Department of Justice as a flood da age expert. During the war he wa consultant for the War Production cilities committee. Other organizati in which he claims membership are A.I.S.N.T., A.S.C.E., American G physical Union, and the American As ciation for the Advancement of Scie He is also the proud possessor of honorary D.Sc. from St. John's in M nesota.

Knowing all of this, it is easy understand why special inspection to were given in his honor whenever visited a national park or federal pr ect such as the T.V.A. dams or breakwater system at New Orlea His travels were not confined to U. S., however, for in the summer 1941 he went to the British West Ind as chief of the engineering division the U. S. Engineers, Trinidad Distr While there he was in charge of construction of lend-lease air bases St. Lucia, Antigua, and British Guia His spare time was consumed pursu his hobby, color photography.

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Refrigeration

Performs many vital services in the production of pharmaceuticals and biologicals for Sharp & Dohme of Philadelphia.

This 100-year-old firm uses Frick refrigeration to condition air, condense alcohol, solidify wax, harden gelatin, and cool drinking water. Also in the production of insulin, and for maintaining even temperatures in vaults where enormous quantities of biologicals are stored. Frick equipment has given dependable service to Sharp and Dohme for over 15 years.

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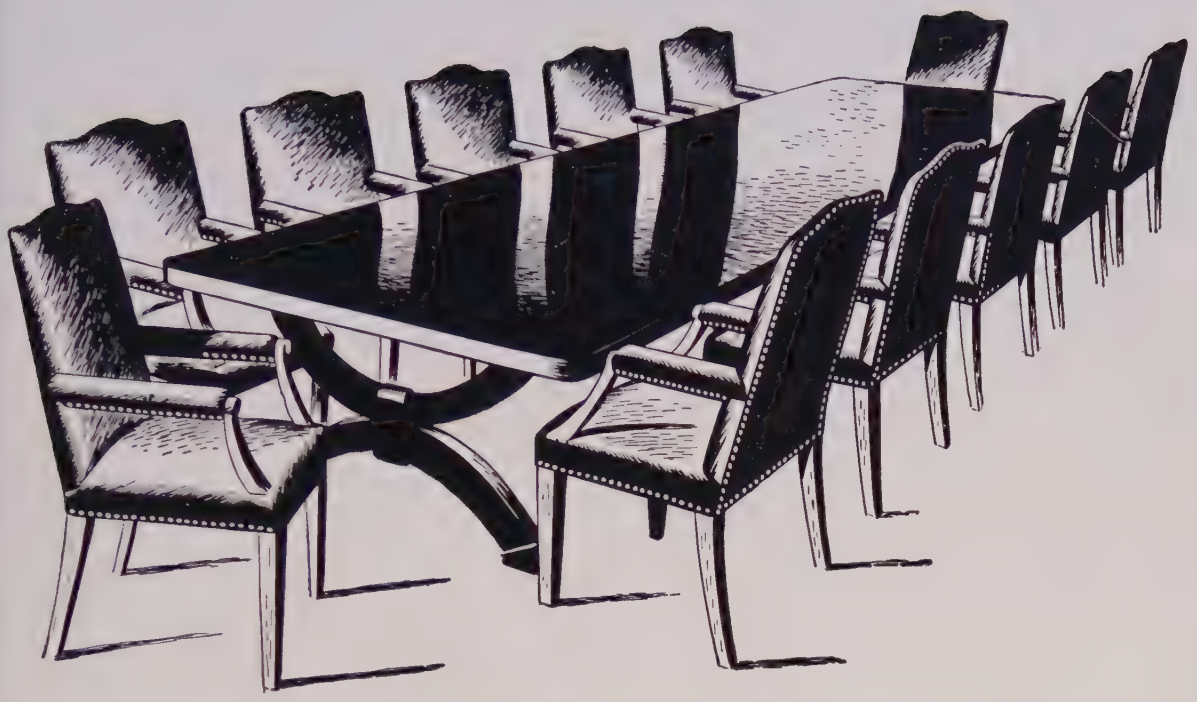

Some chairs to be sat in . . .

And most likely some of the men who will sit at this directors' table during the next forty years are engineering students now. Yes, that seems certain, taking our top management today as an indication. For of the twelve men on our present Board of Directors, seven have come up through science and engineering.

That's why capable engineering students entering our company today feel confident they're beginning a career with a future. They know they're starting in where men of their kind can rise steadily until they play leading roles in the management of our whole organization.

And in a company this size, there is plenty for all to do—many goals, many rewards, many positions of great importance—in research, in production, in marketing, in accounting, in almost any field you can name.

What is more, in this particular company the high managerial posts are filled from within our own organization, by promoting our ablest junior men to top rank. So the Standard Oil employee with unusual ability has unusual opportunity for advancement . . . advancement without limit . . . to the highest chair that he can fill.

STANDARD OIL COMPANY (INDIANA)

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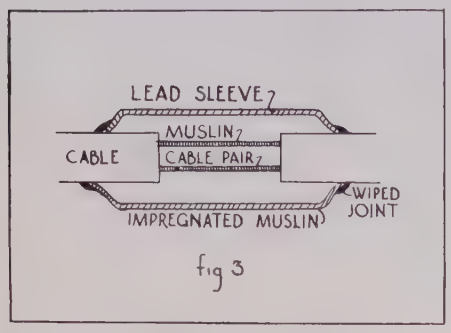
BELL TELEPHONE . . .

rate of gas diffusion through a tightly packed cable was known and it was, therefore, possible to determine whether the rate of diffusion in each splice exceeded that through the standard tightly packed cable. By this comparison method leaking joints were detected. To complete the splice, muslin was wrapped over the lead sleeve and then impregnated with asphaltum.



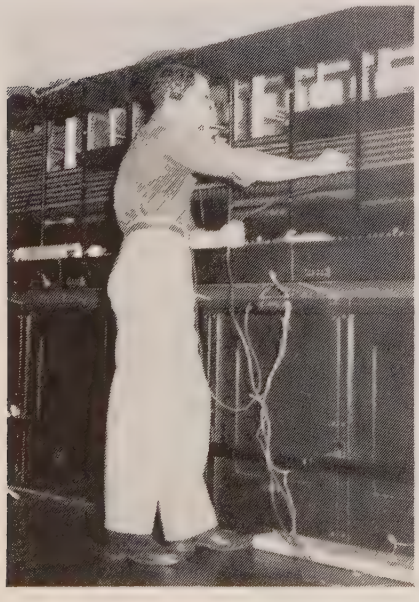
Method of Cable Splicing

Because of its accessibility and central location, the Illini Union building was selected as the site of the new exchange. The switchboard positions are on the mezzanine and the switching equipment is on the west wing of the fourth floor. The equipment used is the step by step type and contains several unique features, one of which is the toll diverting circuit which will be described later.

The three cables coming from campus are merged in the office manhole into two cables comprising 2,100 pairs and 1,500 pairs, respectively, and are carried up to the fourth floor where they terminate on the vertical blocks on the main distributing frame (MDF). The opposite side of the MDF has horizontally distributed blocks and carries the cable to the switchboard with the line arranged in numerical order. Jumpers are then run between the terminals on the blocks on the vertical side to the proper terminals on the blocks on the horizontal side. These jumpers connect the outside plant with the inside plant and also convert the random assignment of telephone numbers to pairs in the underground cable to an assignment of numbers in numerical sequence. Eight Bell-trained operators man the switchboard to handle incoming local and long distance calls.

Approximately 1,500 telephones had been installed and placed in operation when the Bell system became operative on December 14. Of these, about 400 are campus telephones and the remainder regular telephones which enjoy full service. The former designation concerns those telephones which can call only on the campus and cannot make or receive calls from the outside. The regular stations may make and receive calls from anywhere. To make a call off campus, the user dials "9" followed by the telephone number of the desired party. For example, if 7-2689 is to be reached from these stations, the digits 9-72689 are dialed. Long distance calls are made by dialing "0" to reach the University operator who then handles the call to completion.

Bell technician installs switchboard



The Union telephone exchange

The toll diverting circuit previously mentioned is utilized to prevent users from placing long distance calls direct. Without this diverting circuit it would be possible to reach a long distance operator by first dialing "9" to obtain an outside line and then "110," the code number for long distance. If, however, 9-110 is dialed on one of the regular telephones, the call is automatically diverted to the University operator who asks the user to dial "0" and place the call correctly. Because of the toll d verting circuit unauthorized use of to service is prevented.

Through the use of another featu of the Bell service, incoming night cal are automatically connected to a nigh arrangement by means of which any tel phone entitled to receive calls from th outside may be dialed directly. Th means that telephones have complet service 24 hours a day whether or no the operators are on duty.

Thus it may be seen that the attr butes of the Illinois Bell Telephone com pany installation are many, but they ma best be summarized by saying that a the knowledge of how to build an maintain a telephone system to best serv the customer has been made available The result is a fine telephone service an the users at the University are enthus astic about it, indeed.

ENGINEERING SOCIETIES . .

Wayne A. Ring, president; James C Mingee, vice president; William F Meyers, recording secretary; Frankli H. Bayha, corresponding secretary; an Robert P. Saar, treasurer.

CHI EPSILON

At a smoker at the Y.M.C.A. give October 29, Charles Bruggen, presiden of Chi Epsilon, honorary civil engineer ing fraternity, spoke on the history o the society. At this meeting Prof. Jamison Vawter, Wil liam Oliver, J. G. Clark an George Dell were intro duced to members of Ch Epsilon and future plans fo the organization discussed.

Chi Epsilon was founde at the University on Ma 20, 1922, when two inde pendent groups of individuals made u petitions for organization. These tw groups merged and acted cooperativel assisted in their efforts by Dean M. S Ketchum, Prof. Ira O. Baker, and Pro C. C. Williams who lent moral suppor to the plan of organization.

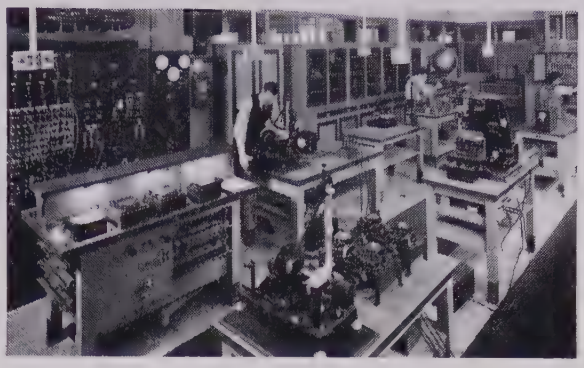
As soon as plans for organization o a local chapter were completed and th ground work laid, the group took th necessary steps to make the society a na tional society. The chapter at Illino Institute of Technology, Chicago, wa actually the sparkplug in attaining na tional status for the fraternity. At th present time Chi Epsilon has 20 chapter in colleges throughout the country an a total membership numbering 3,500.

Present officers are C. Bruggen, pre ident; J. B. Bushman, vice president M. Henderson, treasurer; J. Stallmeye recording secretary; and J. Leek, co responding secretary. Pledges are C

(Continued on Page 24)

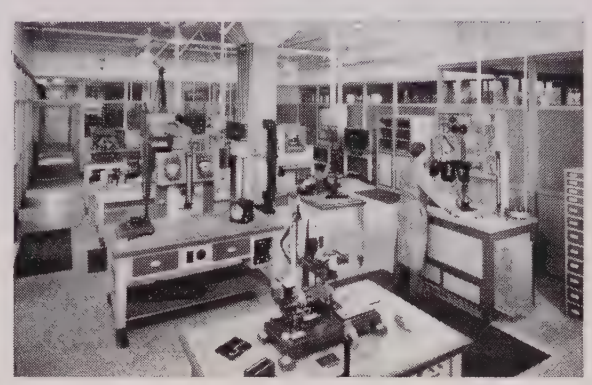
Laboratory Facilities

HOOVER ENGINEERING DEPARTMENT



The Electrical Laboratory designs, tests and redesigns motors and component parts in developing power plants for Hoover Cleaners.

The Testing Laboratory maintains production control by acceptance tests on parts and materials. Test specifications and special test apparatus are developed here.



Filters, fans, materials, processes are tested in the Mechanical Laboratory; air flow and power problems, cleaners and cleaning methods are studied.

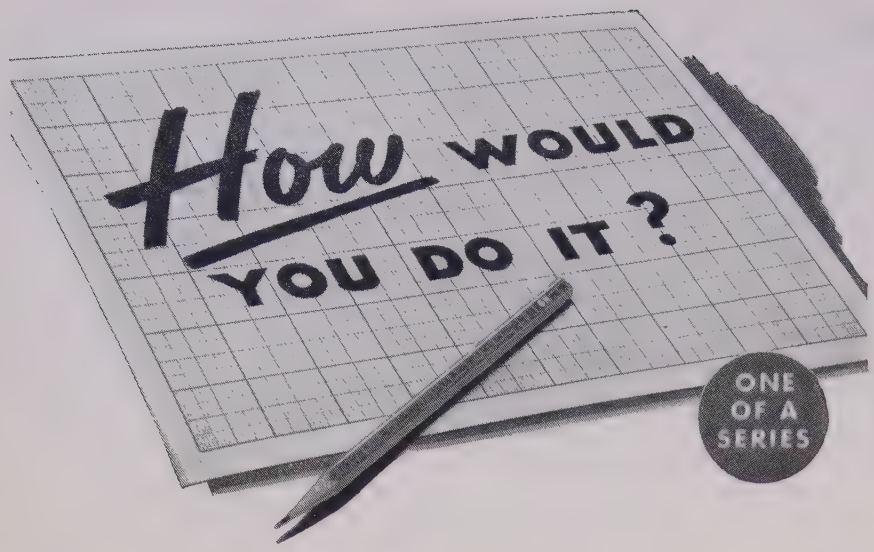
In this modern, fully equipped laboratory exhaustive chemical and metallurgical tests are conducted on metal, fabric, wood, paper and plastics.

A 50-ton room supported on numerous steel springs affords perfect acoustical isolation, insuring precision measurement on noise and vibration problems.

Building the world's largest-selling electric cleaner is big-time engineering, and many thousands of hours of design, tests, research and study go into constructing each new cleaner model.

The Hoover Engineering Department is recognized as a leader. Hoover engineering problems call for the full range of engineering skills—and the best in both equipment and personnel is necessary to handle them.

THE Hoover COMPANY North Canton Ohio



PROBLEM — You are designing a diathermy unit. Included in the electrical circuit are variable elements which must be adjusted during operation. The control knobs must be located where they will be convenient to the operator. The variable elements themselves must be located in the cabinet where they will be easy to mount, to wire and to service. How would you do it?

THE SIMPLE ANSWER

Use an S.S.White remote control type flexible shaft to couple each variable element to its control knob. This simple arrangement makes it possible to place the elements and their controls anywhere you want them. And you will find, too, that operation with these shafts is as smooth and sensitive as a direct connection, because S.S.White remote control flexible shafts are designed and built especially for this type of duty.

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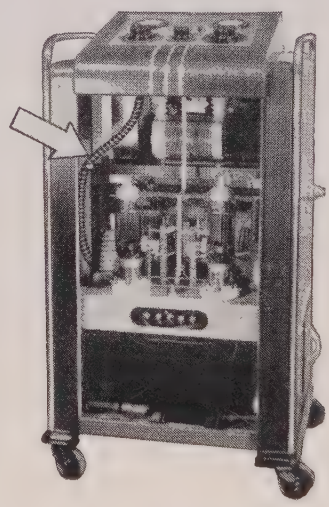
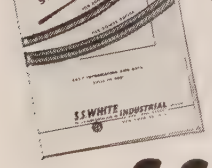
This is just one of hundreds of remote control and power drive problems to which S.S.White flexible shafts provide a simple answer. That's why every engineer should be familiar with the range and scope of these "Metal Muscles"* for mechanical bodies.



Here's how one well known electronic equipment manufacturer did it. The flexible shaft (arrow) connects control knob at top to a variable element at the bottom rear.



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ENGINEERING SOCIETIES . .

Briggs, J. Briscoe, W. Day, B. Ditchik J. Forbes, J. Keith, R. Krug, R. Lich tenberger, H. Luther, M. Rosche, T Smith, G. Thomson, and L. Wilkes.

A.S.C.E.

The first meeting of the A.S.C.E. or October 14 was an annual smoker a which doughnuts and cider were served The University Y.M.C.A. was th meeting place, and Prof. H. E. Babbit officiated as master of ceremonies. Th following meeting on Nov. 5 featured a moving picture on water and sanita tion after which a committee to study traffic conditions on the campus wa appointe. The committee on traffic wil confer with C. C. Wiley, former traffi engineer in Champaign.

Officers for this semester are Thomas L. Thomas, president; Robert F. Krug vice president; James T. Halsey, secre tary; and Monte D. Moss, treasurer.

A.I.Ch.E.

Reorganized this term, the University chapter of A.I.Ch.E. held its first meeti ing on October 22 at which time plan for the semester were outlined an officers elected. Robert Beals was voted in as president; Stan Slazinski, vice presi dent; E. R. Harris, Jr., secretary; an Richard Divilbiss, treasurer. Dr. Harr G. Dickamer is the faculty advisor fo the organization.

At a second meeting on Novembe 13, Prof. H. E. Babbitt spoke on th licensing of professional engineers whic was well received. The December meet ing will feature a talk by a prominer speaker on "Jet Fuels."

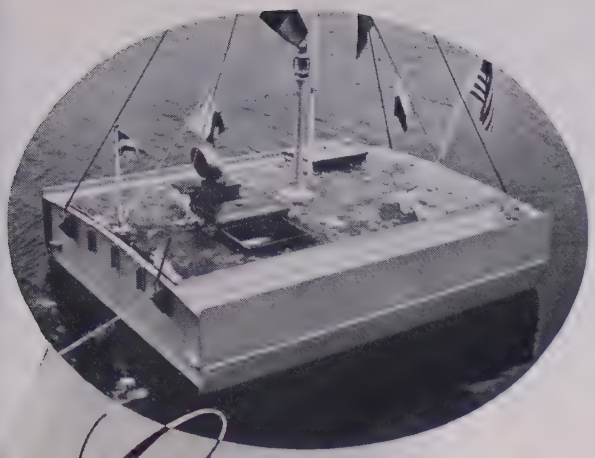
Each second Tuesday of the mont meetings are held. Membership of th organization is now 30.

A.S.M.E.

The officers of the A.S.M.E. for th term are Alex E. McCormak, chai man; Walter Ambery, vice chairma James C. Mingee, secretary; Robert H Kern, treasurer; and Richard Lov assistant treasurer.

Prof. N. A. Parker gave a talk c "The Aims of the A.S.M.E. for th Year" at the October 9 membersh meeting and on October 16, the H. H Robertson company presented a speake and models on the subject of "Indu trial Plant Ventilation." On Octob 29, Prof. H. E. Babbitt talked on th "Professional Engineering Act."

At the November 13 meeting th moving picture "The Tornado in Box," a story about the gas turbin was shown by courtesy of the Alli Chalmers company who also sent a re resentative to speak on the subject.



Cinderella

TAKES A CHINESE HONEYMOON

• The Cinderella of Chesapeake Bay is a queer looking craft. She has no bow, no stern, no engine, no crew. Never weighs anchor to make a voyage. But she *has* a purpose, and has served it well.

Largely because of her, a new fleet of ocean-going passenger ships will have superstructures built of *aluminum*. It reduces weight at the most important place—"topside".

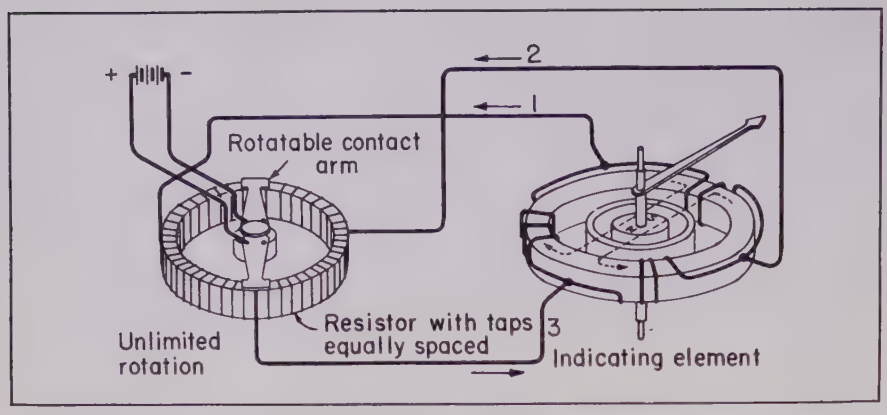
This is a dream come true for Alcoa engineers. Eleven years ago they built this odd-shaped aluminum test hull and anchored it in Chesapeake Bay. Together with marine engineers and naval architects, they watched to see the effect salt water had on aluminum; whether it would prove seaworthy. And it did!

But there were other problems—for instance, stresses topside, set up by the weaving and pounding that a ship takes at sea. By building and testing a model, Alcoa engineers found that the use of aluminum in the superstructure greatly reduced the stresses. They likewise conferred on plans and recommended materials.

So the ships were built. They are in the water now being outfitted for their maiden voyages to China—thanks to Cinderella and the "imagineers" who dreamed of aluminum ships and then engineered them into the water.

Doesn't a company that pursues an ideal with such intensity stir your imagination? It's fun to work with men of vision. Ideas click when men with imagination plus engineering work with this versatile metal, aluminum, and with the greatest fund of aluminum knowledge in the world . . . Alcoa's. ALUMINUM COMPANY OF AMERICA, Gulf Building, Pittsburgh 19, Pennsylvania.

ALCOA FIRST IN ALUMINUM



Schematic Diagram of Selsyn Repeaters

ZINC

for LONG-TIME, LOW-COST PROTECTION AGAINST RUST

ZINC INSTITUTE 2 OZ. COATING SEAL OF QUALITY

The "Seal of Quality", shown above, is the yardstick of economy in buying galvanized sheets. It signifies at least 2 oz. of Zinc per square foot!

The U.S. Bureau of Standards, Circular #80, says, ". . . by far the best" protective metallic coating for rust-proofing iron or steel is ZINC. Zinc, in the form of galvanizing, protects against rust in TWO WAYS: First, by simple coverage, with a sheath of rust-resistant metal . . . Second, by electro-chemical action, or "sacrificial corrosion." That's why industry has long depended on ZINC to stop rust—cut costs—save materials. Heavy coatings pay—for the heavier the coating, the better the protection, the longer the service life and the lower the cost.

FREE BOOKLETS

WRITE TODAY for these valuable booklets: (1) Repair Manual on Galvanized Roofing & Siding (2) Facts About Galvanized Sheets (3) Use Metallic Zinc Paint to Protect Metal Surfaces (4) The Zinc Industry—Mine to Market.

American Zinc Institute

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NEW INSTRUMENTS . . .

explanation for a type DJ-1 Selsyn system. Several types are manufactured by General Electric but this type is used in the test car.

Principles Explained

"The indicating element consists of a laminated ring of ferromagnetic material upon which three windings are placed at equal distances. Varying the position of the brushes on the transmitter coil varies the voltage impressed on each indicator winding, thus changing the flux distribution across the laminated ring. A polarized permanent-magnet rotor within the laminated ring aligns itself with this flux, giving an accurate indication of the position of the transmitter brushes at all times."

Along with all these instruments, a coal metering device connected to the stoker engine is used which measures the rate of coal burned, and a work recorder indicates directly the amount of work output during a given time. It should be easily seen that a quick precise measurement of performance is made available by these instruments. Efficiency tests can be made and recorded for constant runs giving a running record of such things as work output per pound of coal or per gallon of water, steam rate per HP, or steam rate for a given speed. Distance, time, speed, work, etc., are all measured and recorded within convenient distances giving the whole picture in one glance.

Professor Tuthill's work on the water meter should be published soon, having been turned in to the experimental station some time ago. Another test run is scheduled soon for determining performance characteristics under various draft conditions. The new instruments recently developed will be of valuable service for this test.

There was a young maiden . . . a Sioux
As tempting as any home brioux
She displayed her cute knees
As she strolled past tepees
And the braves all hollered "Wiou
Wioux!"

One of the Navy's admirals watched an eager young inductee sloshing the foredeck with a heavy mop. "Well, so how long have you been in the Navy?"

"Just two months, sir," the recruit panted. "How long have you been in the service?"

"Thirty years."

"Hell, ain't it?" sympathized the recruit.

Johnny was a chemist
Now he is no more.
What he thought was H_2O
Was H_2SO_4

Nothing Rolls Like a Ball . . .

. . . and the paddle-athletes above are convinced that "a ball rolls freely in *any* direction!"

This fundamental—plus the fact that a ball is also Nature's favorite, *strongest* form—makes the ball bearing a "natural" for modern industry and its products.

Rugged New Departure Ball Bearings carry heavier loads on tough steel balls. They lick friction and excel for higher speeds and precise positioning. They are produced by the world's greatest ball bearing maker.

New Departure has a vast fund of practical experience to offer you. More than that, it offers *original thinking* in solving your bearing problems.

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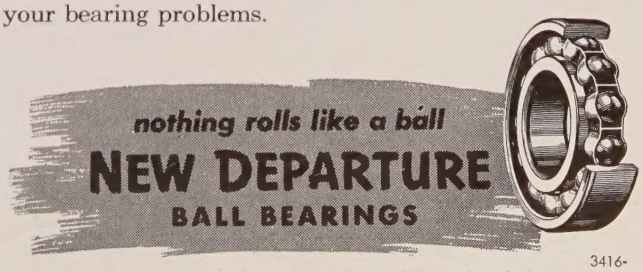
The name "New Departure" aptly describes that organization's brand of thinking. The many new departures by New Departure are stepping stones of engineering progress.



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His lamp could burn for 30 years

on the extra power produced when 2 boilers replaced 6

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This B&W boiler installation typifies the progress made during recent years in raising steam generating efficiency—progress in which B&W has consistently lead the way. B&W, old in experience, has pioneered important advances in many other fields too—yet B&W is still young enough to have new ideas for all industries on present problems and future plans.

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DYNAMOMETER CAR . . .

ing practical railroad tests which cannot be otherwise obtained. The railroad company gets the results of such tests at the least inconvenience to itself."

He pointed out that "dynamometer cars are intended to measure train resistance, and tests made with them fall under two heads: those in which attention is directed to the pulling capacity of the engines, and those in which interest is in the resistance of the train as influenced by its makeup and other conditions. In the first category he listed tonnage rating tests, tests of engine efficiency, and tests to determine the influence of changes in engine design. Under train resistance tests he included studies of freight cars, passenger cars, effect of speed, of empty cars, of roadbed, and of special equipment such as bearings.

He said that with car 609—the University's first—a system of tonnage rating was established on the Peoria and Eastern railway in a series of tests lasting only two weeks. Interestingly, among the first runs made by the new University car when built two years ago were tonnage tests of the Illinois Central's 2500, 2300, and 2800 series of locomotives, and general tonnage tests on the Gulf, Mobile, and Ohio railroad. The principles of tonnage rating developed by the University of Illinois have been nationally recognized and adopted for many years to the great benefit of the railroads of America.

Results of work with the University's railway dynamometer cars have been reported to the public in seven bulletins published by the Engineering Experiment station of the University of Illinois. These results have been widely applied. The bulletins have dealt with freight train resistance, passenger train resistance, effect of wind on train resistance, effect of cold weather on train resistance and tonnage rating, and increases of resistance resulting from curves.

Background History

The history of the cars owned jointly by the University and the Illinois Central begins in 1893 when the railroad exhibited a fancy drovers' car at the Chicago Columbian exposition. After the exposition, this car was turned over to the University for equipping as a dynamometer car. In 1907 it was rebuilt with a steel underframe, and continually, until its scrapping in 1943, the mechanism was kept up to date with frequent improvements and rebuildings as the University engineers devised new and better ways to carry on the work. The car body continued of wood, however, and the car continued to roll on wooden trucks until the last. The car's first number was 17. This was changed to 22 in the 1920's, and in the 1930's was changed to 30 when the railroad set up a new numbering system for special cars. The number 30 has been carried over to the new car which replaced the oldtimer.

This new car was designed by Prof. J. K. Tuthill of the University and built in the Burnside shops of the Illinois Central. Much of the equipment in it was built in the University's shops and it is constantly being improved and added to.

The 60-foot dynamometer car now operated by the University and the I. C. is a very modern piece of railway rolling stock, sleek-sided with the welded joints of its steel plates invisible under coach green paint and yellow lettering. Within, it is divided into three sections, the operating section with recording equipment, bay windows, desk, and workbench, a living section of two staterooms flanked by a corridor; and a well-equipped galley. A diesel generator provides light and power when the car is on siding. The car is normally run with the operating compartment forward, although it can be run in either direction and has junction boxes at each end for the cable to the engine.

Du Pont Digest

Items of Interest to Students of Chemistry, Engineering, Physics, and Biology

Low-Cost Sulfamic Acid Was Result of Newly Discovered Process

Once obscure laboratory chemical now finding wide use in industry

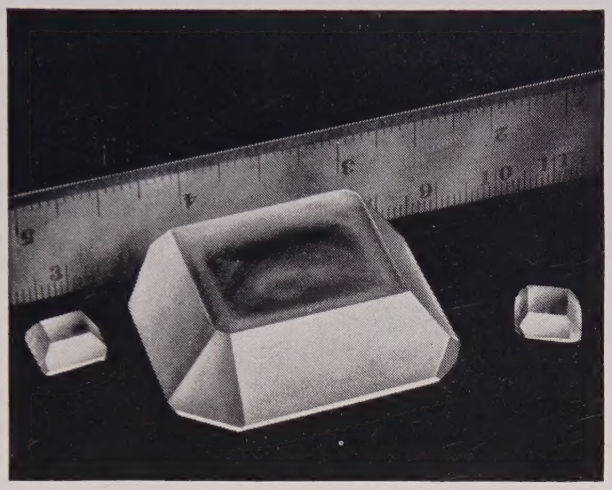
Sulfamic acid, which for years was merely another obscure laboratory chemical, is today being produced in carload quantities for a constantly growing list of uses because of a discovery made by a Du Pont chemist.

Believing that urea could be sulfonated to give a product which might have commercial utility, the chemist treated urea with fuming sulfuric acid. The reaction was exceedingly violent, and it appeared that decomposition had taken place to give ordinary ammonium sulfate. However, the chemist noted that the white precipitate which had formed did not dissolve rapidly in water as ammonium sulfate should, and further investigation proved that he had obtained sulfamic acid.

$$NH_2CONH_2 + SO_3 + H_2SO_4 \longrightarrow 2NH_2SO_2OH + CO_2$$

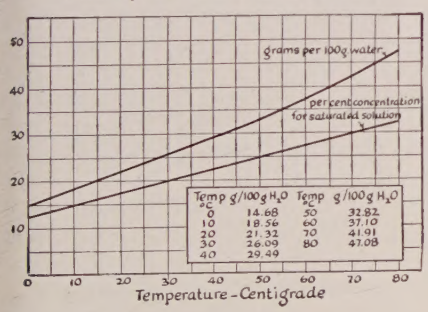
(urea → sulfamic acid)

Thus the way was pointed to an inexpensive method of making this scarcely known chemical, and an intensive study of its chemical and physical properties has led to its development for a wide variety of industrial uses.



Crystals of sulfamic acid

Solubility of Sulfamic Acid in Water


grams per 100g water
per cent concentration for saturated solution
Temperature - Centigrade
0 10 20 30 40 50 60 70 80
10 20 30 40 50

Temp °C	g/100g H_2O	Temp °C	g/100g H_2O
0	14.68	50	32.82
10	18.56	60	37.10
20	21.32	70	41.91
30	26.09	80	47.08
40	29.49		

First Industrial Applications

The salts of sulfamic acid are being used extensively as flame-proofing agents. Highly compatible with cellulose, ammonium sulfamate is unique among fire retardants in that it does not cause stiffening or otherwise adversely affect the hand or feel of textiles and paper.

Another outstanding use for ammonium sulfamate is as a weed killer for the control of poison ivy, ragweed, and a variety of noxious annuals. Its effect on poison ivy is unmatched by any other product.

One of the most important industrial applications for sulfamic acid is based on the fact that it reacts quantitatively and very rapidly with nitrous acid. This has led to its wide use in eliminating the excess nitrite employed in diazotization reactions for dye and colored pigment manufacture.

Soluble in Water and Non-hygroscopic

Sulfamic acid is a strong acid, and despite the fact that it is exceedingly soluble in water, it is a solid non-hygroscopic, non-volatile material which has found application as a laboratory titrimetric standard. Additional information will be found in the bulletin "Sulfamic Acid and Its Salts." Write to 2521 Nemours Bldg., Wilmington, Delaware.

Understandably, men of Du Pont are proud that their work in the laboratory has created and developed many products like this "chemical curiosity" to help make life safer, more pleasant and comfortable for all Americans.

Questions College Men ask about working with Du Pont

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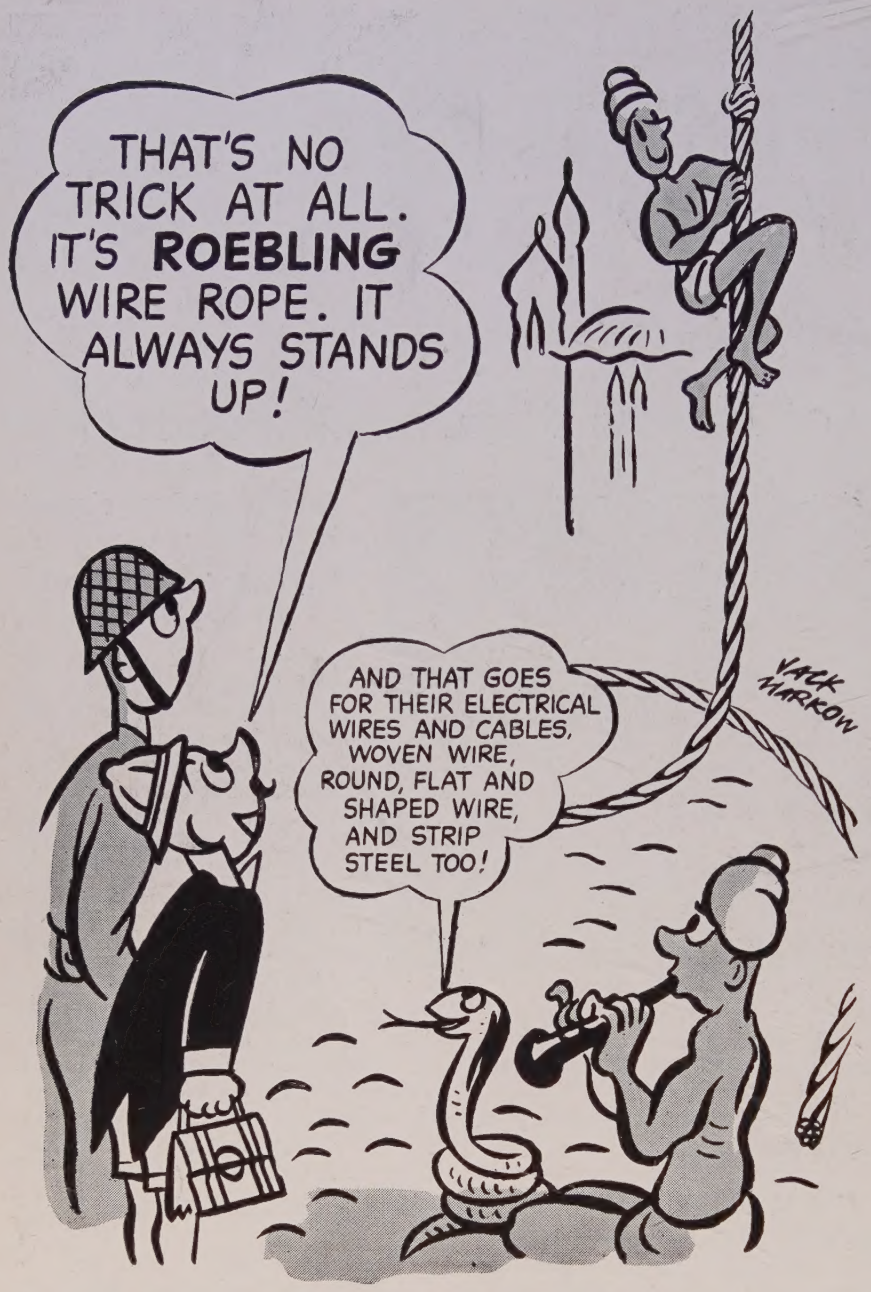
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GAS TURBINES . . .

perature and delivers power at a reaso ably high level. The use of combusti turbine in railway locomotives ha many advantages and promises to ha a great future. For one thing, the pow weight ratio of about 25 lbs. per hp f the complete power unit enables t large locomotive of about 5,000 hp be constructed at a total weight ratio about 125 lbs. per hp! 5,000 hp can crowded into a locomotive less than feet long. The turbine operates at mo erate speed of rotation, does not requi large water supplies and frequent stop burns a grade of oil which costs on half that of Diesel fuel, and lubricati oil consumption is virtually zero single charge of oil is usable for tw years if centrifuged once or twice year).

The gas turbine in the locomotives designed for maximum temperature 1,200 F, since 1,200 F is the maximu temperature that should be adopted f prime mover type of power plants whe continuous operation with reliability is basic requirement. Aircraft gas turbi applications are designed for higher tem peratures but this can be justified whe low atmospheric temperatures at hi altitude permit rapid cooling. Then, t limited service performance is acceptab in those aircraft.

The turbine in a locomotive uses rel tively low grade fuel, so extra provisi for steam or electrical heating is mad No water is required for gas turbi power since all cooling is done by a Cost of the locomotive is about $75 $85 per horse power. A five stage rea tion type gas turbine is employed drive a 22 stage axial compressor. A is filtered and its pressure increas through the compressor. By means turbine exhaust gas in the heat exchan er the temperature of the air is rais further and then forced in paral through a group of twelve separate co bustion chambers ahead of the turbi Some air is used for combustion, wh the remainder flows through inner a outer shells and cools the products combustion to satisfactory turbine in temperature. Use of several small co bustion chambers are used for more s isfactory combustion. The gas plus is then exhausted to the heat exchang which preheats air from the compress

To start from standstill, the gene tor is switched from shunt to series fie bringing unit up to 30% of maxim operating speed, at which point the t bine at full gas temperature is capable driving the unit by itself.

Improvement in thermal efficiency use of regeneration and increased te peratures make the gas turbine a seri aspirant for heavy continuous pow service.